U.S. Army Corps
of Engineers®
Detroit District

SECTION 905(B) WRDA 86
RECONNAISSANCE STUDY OF ECOSYSTEM RESTORATION
FOR THE
CLINTON RIVER AND ANCHOR BAY WATERSHEDS
MACOMB COUNTY AND ST. CLAIR COUNTY, MICHIGAN

Final Report
July 2012

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Section 905(B)
Reconnaissance Study of Ecosystem Restoration
Clinton River and Anchor Bay Watersheds
Macomb County and St. Clair County, Michigan

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1. Study Authority

Resolution Docket 2732 of the Committee on Transportation and Infrastructure of the U.S. House of Representatives dated July 21, 2004 states:

> "*Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers, Red Run Drain and Lower Clinton River, Michigan, Rivers and Harbor Act of 1970, published as House Document 431, 91st Congress, 2nd Session, and other pertinent reports to determine whether modifications to the recommendations contained therein are advisable at the present time in the interest of flood protection, environmental restoration and protection, recreation and related purposes for the Clinton River and Anchor Bay watersheds within the counties of Macomb, Oakland, and St. Clair, Michigan."*

This study is a Reconnaissance Study following the process detailed in Section 905(b) of the Water Resources Development Act of 1986.

The River and Harbor Act of 1970, published as House Document 431, 91st Congress, 2nd Session, as cited above, reads as follows:

> *"The project for flood protection along Red Run Drain and Lower Clinton River, Michigan, is hereby authorized, substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 91-431, except that not to exceed $40,000,000, is authorized for initiation and partial accomplishment of the project."*

Funds in the amount of $325,000 have been appropriated for this study and related tasks in FY 2010. Of that funding amount, $100,000 is allocated for this 905(b) analysis, with the remainder allocated to the production of Project Fact Sheets and a Beneficial Use Impairment Delisting Strategy Plan.

2. Study Purpose

The purpose of this Reconnaissance Study is to identify water resource impairment areas in the Clinton River and Anchor Bay Watersheds in Macomb and St. Clair Counties, Michigan, and to determine if there exists a potential Federal Interest in addressing those impairments through future studies or projects. Along with ecosystem restoration opportunities, flood risk and water quality impairments are also addressed in the study. These impairments include:

- Nonpoint source water pollution, including combined sewer overflows;
- Impacts to wetlands and other wildlife habitat due to urban development in the watersheds;
- Beneficial Use Impairments (BUI's) identified in the U.S. Environmental Protection Agency's (USEPA) Remedial Action Plan and the Great Lakes Water Quality Agreement; and
- Additional issues identified by local stakeholders, including impacts due to county drains, invasive species control, streambank erosion areas, impacts to spawning and nesting areas, and nutrient and bacteria loading leading to beach closing and other health issues.

This Reconnaissance Study includes an analysis of water resource impairments in the Clinton River and Anchor Bay watersheds and a determination of Federal Interest in projects to address those impairments. The analysis was conducted using existing, readily available data, and professional and technical judgment. This Reconnaissance Study was prepared in conjunction with the development of a strategic

plan for BUI delistings in the watersheds and was prepared by the Detroit District of the U.S. Army Corps of Engineers (Corps).

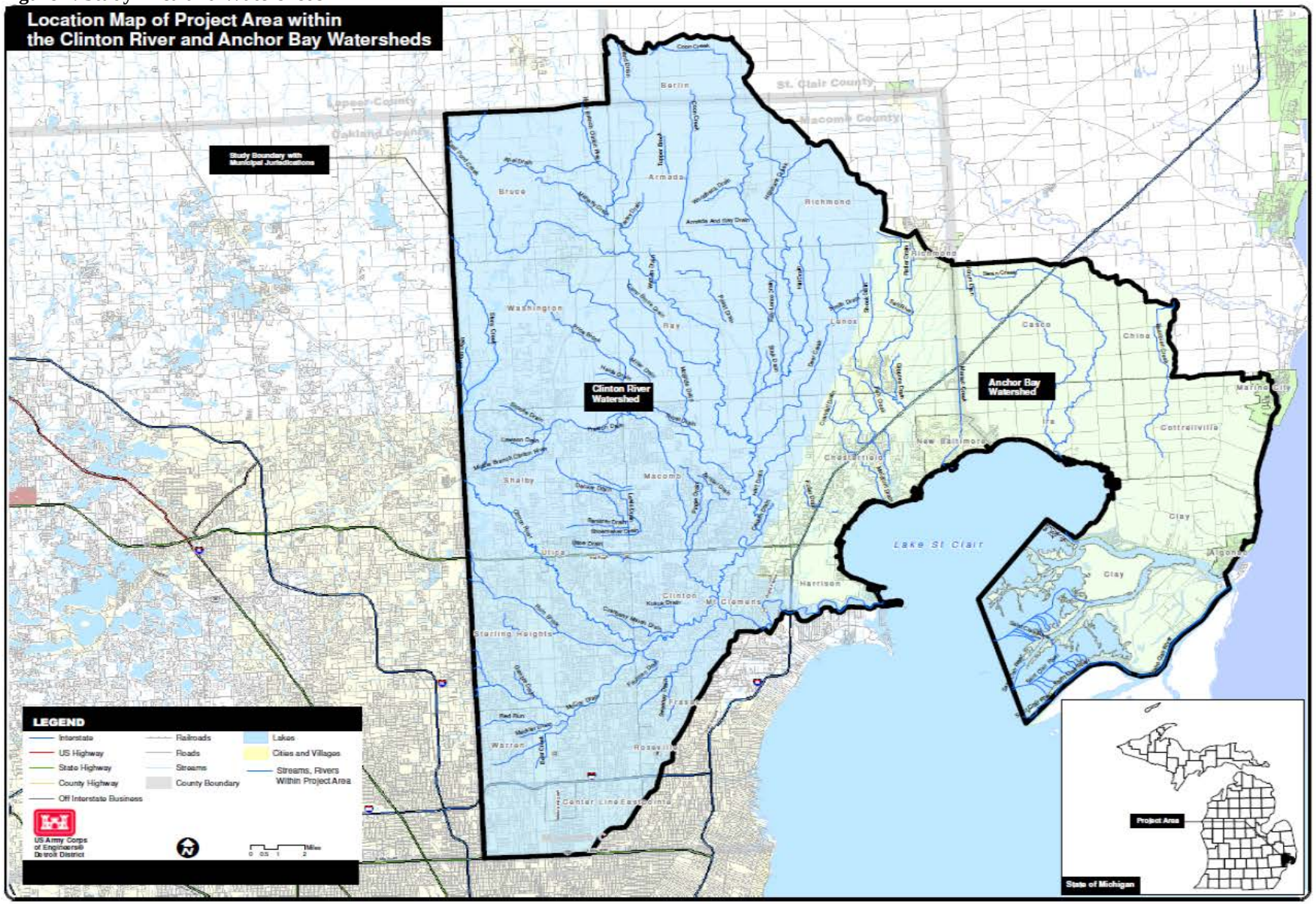
3. Location of Study, Non-Federal Sponsor and Congressional Districts

The study area is located in Macomb and St. Clair Counties in Southeastern Michigan. It includes the portions of the Clinton River Watershed and Anchor Bay Watershed located in those counties.

The Clinton River, located just north of Detroit, flows 80 miles from its headwaters to Lake St. Clair near the city of Mt. Clemens. The river's watershed drains 760 square miles of southeastern Michigan, including portions of Oakland and Macomb Counties and small areas of St. Clair and Lapeer Counties. The portion of the Clinton River Watershed located within northern Oakland County is currently being studied in a watershed reconnaissance study conducted under a separate specific authorization by the Corps' Detroit District. That watershed reconnaissance study is entitled "Reconnaissance Report for the Clinton Watershed Environmental Restoration Northern Oakland County and Lapeer County." This document was completed to complement that study, providing an overview of Federal Interest in water resource issues throughout the entire Clinton River Watershed.

The Anchor Bay Watershed is part of the Lake St. Clair and St. Clair River Drainage System. The watershed encompasses 171 square miles including the Delta islands (Harsens and Dickinson islands), in Macomb and St. Clair Counties. The study area is shown in Figure 1.

Figure 1. Study Area and Watersheds



The study area encompasses all or part of 27 municipal jurisdictions, which are detailed in Table 1. A non-Federal partner or partners have yet to be identified for potential future study efforts.

Table 1: Civil Jurisdictions in the Study Area

Macomb County		St. Clair County
Armada Twp	Mount Clemens	Algonac
Bruce Twp	New Baltimore	Berlin Twp
Centerline	Ray Twp	Casco Twp
Chesterfield Twp	Richmond Twp	China Twp
Clinton Twp	Roseville	Clay Twp
Fraser	Shelby Twp	Cottrellville Twp
Harrison Twp	Sterling Heights	Marine City
Ira Twp	Utica	
Lenox Twp	Warren	
Macomb Twp	Washington Twp	

The study area lies within two congressional districts:

- Candice Miller – (R) – Tenth Michigan District
- Sander Levin – (D) – Twelfth Michigan District

4. Prior Studies and Reports

More than 100 reports and studies were reviewed as part of this Reconnaissance Study. A complete annotated bibliography is included in Appendix B. Key documents used in characterizing existing watershed conditions, developing planning objectives and identifying potential watershed projects are summarized in Table 2.

Table 2: Key Studies Reviewed for the Clinton River and Anchor Bay Watersheds Reconnaissance Report

Report Title and Date	Author	Key Topics
The St. Clair River Area of Concern Water Use Goals Remedial Measures and Implementation Strategy (March 1995)	Ontario Ministry of the Environment and Energy, and Michigan Department of Natural Resources	This document presents the framework for restoring the environmental integrity of the St. Clair River and recommended remedial and preventative actions to reach these goals. Contaminated sediment may have contributed to 5 of 9 BUIs. The distribution of contaminants in the sediments of the St. Clair River is strongly related to industrial and municipal sources. The report identifies sediments impact zones.
St. Clair River and Lake St. Clair Comprehensive Management Plan (2004)	U.S. Army Corps of Engineers, Detroit District	This bi-national management plan identifies sources of pollution and ecosystem degradations in the Lake St. Clair Watershed. It includes goals, summary of environmental conditions, measures for addressing restoration, and an implementation framework. The recommendations identify responsible parties for implementation, which may be applicable in identifying non-Federal sponsors.

Report Title and Date	Author	Key Topics
Stony/Paint Creek Subwatershed Management Plan (November 2005)	Clinton River Watershed Council; Environmental Consulting & Technology, Inc., et. al.	Identifies current sources and causes of impairment in order to determine actions necessary to restore the streams to stable conditions, and recommends actions to prevent further degradation of Stony and Paint Creeks. A recurring theme is the importance of maintaining rural character and natural viewsheds. The plan includes detailed information on existing conditions, a summary of relevant community plans, and recommended actions for watershed management in the subwatershed.
Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes (December 2005)	Great Lakes Regional Collaboration of National Significance	A comprehensive resource report on the physical, chemical, biological, and societal aspects of the Clinton River Watershed. The report includes contemporary data regarding stream flows, pollutants, biological communities, and watershed land use. Intends to serve as an information base for managing the river's future.
Lake St. Clair Coastal Habitat Assessment and Recommendations for Conservation and Restoration Planning (2006)	Great Lakes Commission	Provides a historic and geologic assessment of development in the Lake St. Clair coastal zone. Characterization of hydrology and water quality, ecosystems, plant and animal communities, system stressors and programs to respond to those stressors, and recommendations for coastal habitat management and restoration.
Hydrologic and Geomorphic Analysis of the Clinton River Watershed: Final Report (March 2006)	ECT, Inc.	Develops a detailed picture of the geomorphic and hydrologic variability in the Clinton River and how that variability has been impacted by changes in land use. A key outcome is the quantification of hydrologic/hydraulic driving forces that can help evaluate any future design and implementation of best management practices (BMP's) with more certainty than currently possible. These BMPs could be related to channel restoration, stabilizing stream banks, improving livestock pasture management, and improving road crossings (culverts and single span bridges). Although the study stream is not within the Reconnaissance Study area, the information obtained that can be applied to the watershed as a whole is relevant to the Reconnaissance Study.
Anchor Bay Watershed Management Plan (April 2006)	Anchor Bay Technical Committee, FTC&H	A watershed-wide framework for addressing water quality in Anchor Bay. Some hydrologic and hydraulic elements are included, and sedimentation concerns are discussed. The document summarizes existing conditions, public participation and education strategy, watershed goals and objectives, proposed actions and BMPs, subwatershed and community action plans, and methods of measuring progress.
Special Report 39 – Clinton River Assessment (June 2006)	Michigan Department of Natural Resources, Fisheries Division	Describes physical and biological characteristics of the Clinton River. Serves as an information base for managing the river's future. Includes contemporary data regarding streamflows, pollutants, biological communities, and watershed land use.

Report Title and Date	Author	Key Topics
Red Run Subwatershed Management Plan (October 2006)	Macomb County Public Works Office; Tetra Tech, Inc.; R2W Subwatershed Advisory Group	Includes a description of existing conditions in the watershed and actions to improve water quality. Proposed actions are divided into eight categories: watershed planning, public education and participation, ordinances and zoning, pollution prevention, stormwater BMPs (non-construction sediment), stormwater BMPs (other pollutants), natural resource management, recreation enhancement. The goals and actions in this study are correlated to the Clinton River AOC BUI delisting targets.
Lake St. Clair Direct Drainage Subwatershed Management Plan (October 2006)	Macomb County Public Works Office; Tetra Tech, Inc.; LSC DD Subwatershed Advisory Group	Although the planning area covered in this document is almost entirely out of the planning area for this Reconnaissance Study, portions of some communities are relevant, and the description of open water conditions is also relevant. The plan includes a description of existing conditions in the watershed and actions to improve water quality. Proposed actions are divided into eight categories: watershed planning, public education and participation, ordinances and zoning, pollution prevention, stormwater BMPs (non-construction sediment), stormwater BMPs (other pollutants), natural resource management, recreation enhancement.
St. Clair County's Northeastern Watersheds Watershed Management Plan (November 2006)	St. Clair County's Northeastern Watersheds Watershed Advisory Group	Includes a description of existing conditions in the St. Clair River Direct Drainage and Lower Black River Watersheds and actions to improve water quality. It identifies prioritized pollutants, their source, and their impacts to the watersheds. Priority areas to be protected and preserved and critical areas for corrective action are identified as well. Finally, it describes specific tasks or actions that each community can use to address the goals and objectives of the Watershed Management Plan.
City of Sterling Heights Stormwater Management Plan (March 2007)	City of Sterling Heights	Describes necessary measures to reduce the discharge of pollutants from the stormwater drainage system, to protect water quality, and satisfy the Federal and Michigan Water Pollution Control Acts. The document includes a public education plan, a public involvement and participation plan, an illicit discharge elimination plan, a post-construction stormwater management program, a construction site stormwater runoff control program, and a pollution prevention and good housekeeping plan. Current watershed conditions are identified within these sections.
Lakewide Management Plan Updates for the Great Lakes (2008)	Great Lakes Commission	Updated comprehensive resource report on the physical, chemical, biological, and societal aspects of the Clinton River Watershed. Includes contemporary data regarding streamflows, pollutants, biological communities, and watershed land use.

Report Title and Date	Author	Key Topics
Clinton River Watershed / Area of Concern Clinton River Restoration Plan (2008)	Tetra Tech, Inc.	Updates the actions to address the beneficial use impairments in the Clinton River AOC, with the primary purpose being to restore the eight beneficial uses that have been classified as impaired. One of the most significant findings that came out of the hydrologic modeling results was the cumulative effect of management scenarios in terms of improving water quality. Different BMPs address different issues across the landscape and there is no one management technique that is a cure all. The report defines a framework in which to understand, assess, and address stressors such as nutrients, pathogens, and hydraulics, with respect to the natural environment. The study can be useful in targeting the project study area for the recon report with specific actions.
Clinton River Watershed AOC Clinton River Restoration Plan (2008)	Tetra Tech, Inc.	A comprehensive Remedial Action Plan document that updates the actions to address the beneficial use impairments, with the primary purpose being to achieve delisting of the watershed as an Area of Concern through restoration of the eight beneficial uses that have been classified as impaired.
Clinton River Watershed Area of Concern (AOC) Remedial Action Plan Update (November 2008)	Tetra Tech and Clinton River Public Advisory Council	Provides information on existing conditions at a high level of detail. Includes specific actions recommended to address delisting of Beneficial Use Impairments (BUIs). Details the key environmental stressors in the watershed. Study area for this report includes both the upper and lower Clinton River Watershed.
Delisting Targets for Fish and Wildlife Beneficial Use Impairments (BUI) for Clinton River AOC (May 2009)	Environmental Consulting & Technology, Inc.	Identifies existing conditions in the Clinton River Watershed: trends in water quality and quantity, the biological community in the river, and trends in sediment contamination. Identifies potential projects for meeting delisting targets in the watershed.
Strategy for Delisting Michigan AOCs (January 2010)	Michigan Department of Environmental Quality	This document identifies actions to achieve BUI delisting, criteria, support needed, status of assessment and projected timeframe. Actions needed are described as belonging to planning/design, remedial action, monitoring, and documentation/assessment. The document includes an Action Table that can be searched for relevant projects in the Clinton River subwatersheds.
Great Lakes Restoration Initiative Action Plan FY2010 – FY2014 (February 2010)	White House Council on Environmental Quality	Methods and actions to advance implementation of the Great Lakes Restoration Initiative through FY 2014 to help protect and restore the chemical, physical, and biological integrity of the Great Lakes Basin ecosystem.
Preliminary Analysis of Ecosystem Restoration for the Clinton River Watershed Northern Oakland County and Lapeer County 95% Draft (March 2011)	U.S. Army Corps of Engineers, Detroit District	This Reconnaissance Report is focused on the Upper Clinton River Watershed. The investigation summarizes existing conditions in the watershed and recommends projects as meeting criteria for Federal Interest. The locations, costs and basic scope of ten of improvements are identified in this Reconnaissance Study. The document provides relevant studies for cross referencing in our project study area that overlap both projects.

5. Plan Formulation

As part of this investigation, the Corps coordinated with interested Federal, state, local and non-governmental entities to identify problems and opportunities for ecosystem restoration in the Clinton River and Anchor Bay Watersheds. In addition, a literature search and review was conducted to identify available information regarding water resource impairments. Correspondence with interested stakeholders was conducted to identify potential ecosystem restoration and enhancement opportunities for further study, and in-depth meetings were held with stakeholder groups. Also, discussions were held with potential non-Federal partners to determine their interest and capability in participating in feasibility phase investigations.

Plan formulation was conducted using a five-part process. First, a profile of existing conditions was developed, including a summary of existing water resource conditions related to habitat, recreation, and water quality within the watershed; and specific watershed problems and impairments were identified related to the degraded ecosystems. Second, planning objectives and constraints were specified. Third, ecosystem restoration opportunities were identified. Fourth, selected sites were evaluated for potential Federal Interest.

Federal Planning Principles and Guidelines

The formulation process used in this preliminary analysis is consistent with the national objectives as stated in the Planning Guidance Notebook (Engineering Regulation 1105-2-100, April 2000). In accordance with the Planning Guidance Notebook, plans must contribute to the National Economic Development (NED) consistent with protecting the nation's environment. Ecosystem restoration plans must contribute to National Ecosystem Restoration (NER) through restoration of degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Plans to address identified needs in the study area must be formulated to maximize NED benefits while providing a complete, effective, efficient, and acceptable plan of protection. These requirements are defined as:

- Complete - defined in ER 1105-2-100 as the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities;
- Effective - defined as the extent to which the alternative plans contribute to the achievement of the planning objectives;
- Efficient - defined as the extent to which an alternative plan is the most cost-effective means of achieving the objectives;
- Acceptable - defined as the extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policies and opinion.

Planning Objectives and Constraints

Based on the key water resource problems identified by stakeholders through literature review and direct contact, a number of overarching opportunities and objectives were developed. These are stated in a manner to allow either quantitative or qualitative measurement. The following objectives will be used to assess the ability of potential projects to meet the most pressing water resource needs in the Clinton River and Anchor Bay Watersheds. Projects will:

- Preserve, maintain, and, to the extent possible, enhance the resources of the existing natural and social environment in the project area;
- Improve biodiversity and populations by creating a net increase in area of aquatic and terrestrial habitat, improving habitat quality, and removing obstructions to aquatic and terrestrial organism movement through the corridor;

- Preserve and enhance, to the greatest extent possible, existing open space areas and associated recreational opportunities in the project area; and
- Be compatible with future economic development opportunities.

Ecosystem restoration alternatives that satisfy area needs and objectives are partially limited by economic, environmental, and technical constraints:

- Improvements for ecosystem restoration purposes shall have benefits in excess of estimated costs;
- The projects must be feasible from technological and engineering standpoints, socially acceptable and cost effective, using proven technology;
- Identified alternatives are within the authority of THE CORPS and the non-Federal partners to implement;
- Plans may not negatively impact critical historic or archaeological resources;
- Plans must be consistent with state and local land use regulations;
- Plans should employ some type of accepted methodology and demonstrate a reasonable chance of success;
- There is a reasonable assurance that a public entity (i.e., state or local unit of government) is capable and willing to participate as a non-Federal partner in a cost-shared feasibility study;
- Federal funding limitations may result in an inadequate or inconsistent funding stream.
- Portions of the riparian corridors in the Clinton River and Anchor Bay Watersheds are privately owned. This can make coordination of efforts challenging.
- The watersheds lie in multiple counties, townships, and cities, creating potential for jurisdictional friction.

5a (1) Existing Conditions in the Clinton River and Anchor Bay Watersheds

This section characterizes existing conditions in the Clinton River and Anchor Bay Watersheds. It focuses on key water resource impairments identified in the review of plans and reports and through stakeholder outreach activities, including sedimentation, water quality, habitat and water-based recreation conditions in the watersheds. This section includes a description of likely future water resource conditions if actions are not taken to address the needs identified in planning studies. It concludes with the identification of key water resource problems and opportunities.

Physical and Demographic Overview

The study area, shown in Figure 1, is defined as the portion of the Clinton River and Anchor Bay Watersheds located in Macomb and St. Clair Counties, Michigan. (The Anchor Bay Watershed is a subwatershed of the larger St. Clair River/Lake St. Clair Watershed.) Portions of the study area lie within the boundaries of the Clinton River and St. Clair River Areas of Concern (AOC's) as designated by USEPA and the State of Michigan.

Population in Macomb County grew by 6.7% between 2000 and 2010, to 840,978 persons. Population in St. Clair County fell very slightly by 0.7% in that period, to 160,040. The Southeastern Michigan Council of Governments (SEMCOG) forecasts that both counties will grow in population over the next 25 years, with Macomb County reaching approximately 920,000 inhabitants by 2035. Likewise, St. Clair County is expected to reach a population of 192,000 by 2035.

Land use in the study area is dominated by agricultural and single family residential uses. According to 2008 SEMCOG data, 25% of the study area is cultivated for agriculture, and an additional 41% of land area is used for housing. Approximately 8% of the study land is devoted to parks, recreation and open space. In general, the Clinton River Watershed is heavily urbanized in the southern portion, with less intense development and agricultural uses in the northern portion. The St. Clair River Watershed is partly urbanized in the southwest, with spot urbanization and agricultural elsewhere within the basin.

Table 3 provides an overview of physical and demographic characteristics of the areas of the watersheds included in this study.

Table 3: Physical and Demographic Overview of Study Area

Characteristic	Clinton River Watershed	Anchor Bay Watershed
Overall drainage area	760 square miles	171 square miles
Drainage area in study area	377 square miles	171 square miles
Number of civil communities in study area	27	
Population in Macomb and St. Clair Counties 2010	1,004,018	

Flood Risk Management, Water Supply, Sedimentation, Stream Bank Erosion

Water resources management issues within the Clinton River and Anchor Bay Watersheds present a series of interrelated problems, and opportunities for improving both water quality and habitat. Management of land use policies, identified impairments, and future development can have correlated impacts on flood risk, water supply, sedimentation, and stream bank erosion.

Both the Anchor Bay and Clinton River Watersheds are susceptible to flooding events. Riverine flooding is most often due to heavy precipitation and snow melt in addition to the buildup of sediments and debris. Flooding is not restricted to the main branches of waterways but also areas adjacent to creeks, streams and lakes. While riverine flooding is related to intense rain event, the Lake St. Clair shoreline experiences lake-related flooding due to a combination of high lake water levels and strong winds.

Urban flooding is caused by inadequate storm and sanitary sewer systems coping with high volumes of stormwater runoff in developed areas with high ratios of impervious surface. Related to this issue is lack of protection by natural features that assist with flood reduction, such as adequate buffer zones, undeveloped floodplains and features such as swales and wetlands. Heavy rains may cause flooding during the summer or fall, although these are normally localized and have more impact on watercourses with smaller drainage areas. Typically this results in basement floods, most commonly in the urbanized areas of Harrison Township, St. Clair Shores, Fraser, Clinton Township, Chesterfield Township, Macomb Township, Roseville, Eastpointe and Mount Clemens. Major flooding inundated many areas of St. Clair County and Macomb County in May 2004, causing more than $10 million in property damage.

As with flood risk, land use within the Anchor Bay Watershed has a direct effect on water quality, which in turn impacts the health of the aquatic system. Data compiled by SEMCOG forecasted an increase in the

number of households within the watersheds by approximately 58 percent between 2000 and 2030. This development will increase the impervious area in the watersheds and decrease the land areas providing natural treatment and storage of stormwater runoff; it will also increase the harmful impacts associated with nonpoint source stressors such as flow quantity, sediment, nutrients, bacteria, and chemical contaminants. The available habitat for fish and wildlife within the watershed will decrease commensurately (Anchor Bay Technical Committee, 2006).

Urban development within the watersheds has resulted in increased stormwater peak flows, volumes, transfer of nutrients, and polluted runoff. High peak flows are common within many areas of the AOC and cause erosion of the stream banks and sediment deposition. High peak flows and the resulting stream bank erosion and sedimentation have been recognized as impacting in-stream and nearshore habitat and degrading wildlife populations. The effects of bank erosion and sedimentation are specifically discussed below.

St. Clair and Macomb Counties, as well as most of the communities in the Anchor Bay Watershed, are regulated under the National Pollution Discharge Elimination System (NPDES). Stormwater runoff has traditionally been regarded as a non-point source discharge; it is now regulated as a point source. Instead of imposing discharge limitations and stormwater control programs, the Michigan Department of Environmental Quality (MDEQ) allowed local units of government to establish goals to improve water quality through development and implementation of a watershed management plan. Ultimately, the effectiveness of these management plans will have a profound effect on the health of the watershed.

The Watershed Conceptual Model (discussed later) outlines the relationships between sources of stress on water resources and the related resource impairments. Some of the stressors that have been identified within the study area watersheds are:

- Bacteria (originating from agricultural runoff, pet and wildlife waste, failing septic systems, improper or illegal connections to the stormwater system);
- Soil erosion and sedimentation (stormwater flows, construction sites, road/stream crossings);
- Nutrients (excessive fertilization in residential areas, agricultural runoff);
- Flow rates (increased impervious areas); and
- Invasive species (aquatic and terrestrial via various vectors including ballast water, etc.).

The main stressors include sediment from soil erosion and sedimentation, nutrients, and elevated stormwater flows.

The river system in the upstream reaches of the Clinton River Watershed has a well-connected, developed floodplain. Gradually, the stream morphology transitions to an incised river system in the more downstream reaches. This transition is evidence that the accumulating effect of increased flows generated from upstream reaches is beyond the original channel's capacity to handle these flows, resulting in excess erosion and incision on the downstream reaches. The hydrology data from USGS gage 04164800 located at Romeo Plank Road on the Middle Branch of the Clinton River has shown a substantial increase in flows over the monitoring time period corresponding to the increased development in the area. The change in streamflow trends for the peak flows, annual mean flows, and bankfull flows for the collected time periods (1959-1991) increased 30%, 87% and 57% respectively (ECT, 2006). In addition to stream flow in the upper watershed, nearshore habitats (including coastal wetlands such as the 2,500 acre St. Johns Marsh) are influenced by water level changes within Anchor Bay (as an extension of Lake St. Clair), and could be affected by flood risk management policies (Anchor Bay Technical Committee, 2006).

Many of the other impairments and goals outlined for the watersheds in various planning documents are directly influenced by flow within the channel. For example, the USEPA has defined degradation of fish and wildlife populations as a BUI for the Clinton River Watershed, and reducing the flashiness of the river would provide better habitat and aid in rehabilitating populations. In this and other situations, the role of streamflow in exacerbating or influencing an impairment is a consideration. Additional impairments such as degradation of the benthos and restrictions on fish and wildlife consumption affect the nearshore environments of Anchor Bay.

Public water supply is listed as a threatened designated/beneficial use in Anchor Bay and the Anchor Bay Watershed (Anchor Bay Technical Committee, 2006). As such, protecting drinking water supplies at the point of intake is a long term goal for protecting public health within the Anchor Bay Watershed Management Plan. This requires management of flow, nutrients, and pollutants within the watersheds and the open waters of Anchor Bay and Lake St. Clair, which contains four intakes in U.S. waters and five in Canadian waters (USACE, 2004), serving 4.5 million people (ECT, 2006).

Ground Water Quality

The most common impairments to ground water quality involve aesthetic problems associated primarily with high concentrations of hardness, iron and sulfur which occur naturally in the subsurface geology (Aichele, 2005). It is important to note that a 2000 U.S. Geologic Survey (USGS) report illustrated a significant change in groundwater quality linked to residential development near Detroit. Groundwater that recharged after 1953 (post-suburbanization of the study area) had significantly higher concentrations of chemicals derived from human activities than groundwater recharged before 1953 (USACE 2004). Continued monitoring of groundwater quality is important.

River Water Quality

E. Coli is listed as a known cause of partial and total body contact BUI for recreation uses (Anchor Bay Technical Committee, 2003 Vol II). It is commonly found in concentrations indicating contamination within the Clinton River Watershed, especially following wet conditions (ETC, 2006).

Table 4 illustrates that BUIs caused by water quality concerns in Anchor Bay and the Anchor Bay Watershed include partial and total body contact, degradation of aesthetics, and eutrophication or undesirable algae. These impairments can be attributed to elevated *E. coli* concentrations, excessive nutrients or sediments (Anchor Bay Technical Committee, 2006).

Within the Clinton River, an overall improvement in water quality (from a chemical analysis standpoint) is indicated when data from the 1966-1970 time period is compared with more recent data (2000-2003). Nutrients such as nitrate, phosphorus, and sulfate all showed declines in concentration. In contrast, total dissolved solids and chloride have approximately doubled during this period (Aichele, 2005).

Table 4: Relationship of Beneficial Use Impairments to Water Quality

Designated (D) and Beneficial (B) Use Determinations	Impairment Status (k) = known (s) = suspected	
	Anchor Bay	Anchor Bay Watershed
Partial body contact (D), (B)	Impaired by elevated *E. coli* concentrations (k)	Impaired by elevated *E. coli* concentrations (k)
Total body contact between May 1 and October 31 (D), (B)	Impaired by elevated *E. coli* concentrations (k)	Impaired by elevated *E. coli* concentrations (k)
Degradation of aesthetics (B)	Impaired by excessive aquatic plant growth (k)	Impaired by excessive nutrients and sediment (s)
Indigenous aquatic life and wildlife (D), (B)	Impaired by loss of habitat (k)	Impaired by loss of habitat (k)
Eutrophication or undesirable algae (B)	Impaired by excessive aquatic plant growth (k)	Impaired by excessive nutrients (s)
Warmwater/coldwater fisheries (B), (D)	Not impaired	Impaired by loss of habitat (k)
Degradation of benthos (B)	Impaired by loss of habitat (k)	Impaired by loss of habitat in tributaries (s)
Public water supply at point of intake (D), (B)	Threatened	Threatened
Agriculture (D), (B)	Not impaired	Not impaired
Industrial water supply (D),(B)	Not impaired	Not impaired
Navigation (D)	Not impaired	Not impaired
Degradation of phytoplankton and zooplankton populations (B)	Unknown	Unknown
Restrictions on dredging activities (B)	Not impaired	Not impaired
Bird or animal deformities, reproductive problems (B)	Unknown	Unknown
Fish tumors or other deformities (B)	Unknown	Unknown
Degradation of fish and wildlife populations (B)	Unknown	Unknown
Tainting of fish or wildlife flavor (B)	Not impaired	Not impaired

Source: Anchor Bay Watershed Management Plan, 2006

Lake Water Quality

In general, the health of the Clinton River and Anchor Bay Watersheds is an indicator of the health of Anchor Bay and Lake St. Clair. As such, nutrient levels and fecal bacteria are some of the main sources of BUIs. A monitoring program in the Anchor Bay Watershed was implemented in 1998. This program sampled for standard water quality parameters under wet and dry weather conditions. The results of the program are published in the *Lake St. Clair Water Quality Assessment*. Fourteen parameters were sampled near outfalls entering Lake St. Clair, including storm drains and river mouths, at offshore locations one-quarter mile from shore, and at inland locations generally one-quarter mile upstream from waterway discharge points.

Table 5 shows a summary of the sampling performed at various locations. The data in Table 5 show elevated nutrient and total suspended solid levels. High nutrient (generally phosphorus and nitrogen) concentrations can affect water quality, potential for growth of invasive species, and fish and wildlife habitat.

Table 5: Summary of Water Quality Results

Parameter	Levels of Concern[1]	Mean Value / Highest Reported Value	Summary
Aluminum		0.33 mg/L 1.1 mg/L	-Summer levels were highest for near shore, and fall for off shore. -No significant difference for near and off shore values. -No significant difference between wet and dry samples. -Higher than average values appeared at Irwin Drain (98, 99, 00), Salt River (99, 00), River Voss (98) and Marsac Drain (98). -Three year average (near shore): Salt River, 0.596 mg/L; Irwin Drain, 0.559 mg/L; Crapau Creek, 0.297 mg/L.
Ammonia-N	>0.2 mg/L	0.04 mg/L 0.32 mg/L	-No apparent seasonal trends -Near shore values were significantly higher than off shore values -Irwin Drain exceeded threshold (0.32 mg/L) in fall of 1999 and has an overall average (three years) of 0.113 mg/L. -Dykeman drain had a value of 0.2 mg/L in fall 1999. -Salt River had the second highest overall average with 0.074 mg/L.
Biochemical Oxygen Demand (BOD)	>4 mg/L	0.32 mg/L 3.5 mg/L	-Averaging all data BOD values were highest in the summer for near and off shore locations. -Near shore values were higher than offshore values -All samples were below threshold value/RDL. -Salt River had a reading of 3.5 mg/L (near shore) in summer 2000, 2.2 mg/L (near shore) in spring 1998 and 3 readings in 1999 and 2000 that averaged around 2.3 mg/L (off shore).
Chemical Oxygen Demand (COD)		1.27 mg/L 17 mg/L	-COD was only sampled in 1998 -Schmidt Drain, River Voss and Dykeman Drain were below RDL for COD (near shore). -All other near shore locations had at least one reportable level. -All off shore samples were below RDL.
Chloride		20.6 mg/L 92 mg/L	-Near shore samples were higher than off shore -Dry and wet weather samples were not significantly different. -High concentrations at Irwin Drain and Salt River
Chlorophyll-a	>14µg/L – EPA level	0mg/L 0 mg/L	-Only sampled in 1998 -All results were below RDL.[2]
Dissolved Oxygen (DO)	<5 mg/L	Range (2.55 – 13.5 mg/L)	-DO values were the lowest in the summer. -Near shore values were lower than off shore values. -Locations with highest averages: Irwin Drain, Salt River and Dykeman Drain.

Notes: *Threshold limits/ sample information and some conclusions from Macomb County Health Department.
*Trends are compiled from the Macomb County - Lake St. Clair Water Quality Assessment (1998, 1999, 2000)
1. Levels of concern from Macomb County Health Department, Michigan water quality standards and personal communication with Joe Rathbun and Mark Oemke from MDEQ.
2. RDL = Reportable Detection Limit

Table 5 Continued

Parameter	Levels of Concern[1]	Mean Value / Highest Reported Value	Summary
Nitrate	>0.3 mg/L	0.26 mg/L 1.6 mg/L	-Spring levels were highest for both near and off shore locations. -No significant difference for near and off shore values. -Nitrate levels exceeded the pollution threshold for almost every spring sample at every location (near and off shore). -Crapau Creek exceeded 7 out of 9 near shore samples with a high value of 1.6 mg/L. -Salt River exceeded all three samples in 2000 with a high of 0.89 mg/L.
Nitrite		0 mg/L 0 mg/L	-Levels were below detection limits for all samples.
Ortho-Phosphorus (ortho-P)		0.02 mg/L 0.11 mg/L	-Averaging all data, near shore values were highest in the springtime and off shore values were highest in the fall by a small margin. -Near shore values were higher than off shore values. -No significant difference between wet and dry weather samples. -High three year averages (near shore): Salt River, 0.0423 mg/L; Irwin Drain, 0.034 mg/L; Dykeman Drain 0.0234
Total Kjeldahl Nitrogen (TKN)		1.0 mg/L 8 mg/L	-No significant seasonal trends. -Off shore TKN values were higher than near shore values. -High three-year averages (off shore): Crapau Creek, 2.2 mg/L; Irwin Drain, 1.91 mg/L. -High three year averages (near shore): Irwin Drain, 0.59 mg/L; Salt River, 0.55 mg/L; Dykeman Drain, 0.52 mg/L.
Total Organic Carbon (TOC)	>10 mg/L	3.9 mg/L 9.2 mg/L	-No significant seasonal trends. -Near shore samples were higher than off shore. -Irwin Drain had the highest 3 year average of 5.81 mg/L, Salt River's average was 5.5 mg/L and Marsac Creek's was 3.84 mg/L.
Total Phosphorus (Total P)	>.05 mg/L	0.045 mg/L 0.17 mg/L	-Near shore values were highest in the spring and no significant seasonal trend was found in the offshore values. -Near shore values were significantly higher than off shore values -High three year averages (near shore): Salt River, 0.0978 mg/L; Irwin Drain, 0.0864 mg/L.; Dykeman Drain 0.056 mg/L
Total Suspended Solids (TSS)	>80 mg/L – RPO level	17.6 mg/L 170 mg/L	-TSS was sampled in 1998 and 1999. -TSS levels were highest in the spring. -Near shore values were higher than off shore values. -Wet weather samples were higher than dry weather samples. -Two-year averages include (near shore): Dykeman Drain, 43.5 mg/L; Irwin Drain, 30.5 mg/L; Marsac Creek, 26.5 mg/L. -Many locations were over the mean value

Notes: *Threshold limits/ sample information and some conclusions from Macomb County Health Department.
*Trends are compiled from the Macomb County - Lake St. Clair Water Quality Assessment (1998, 1999, 2000)
1. Levels of concern from Macomb County Health Department, Michigan water quality standards and personal communication with Joe Rathbun and Mark Oemke from MDEQ.
2. RDL = Reportable Detection Limit

Source: Lake St. Clair Water Quality Assessment, 2007

Most inland lakes within the study area are classified as mesotrophic, as they exhibit an intermediate level of productivity that is greater than oligotrophic lakes, but less than eutrophic lakes. These lakes often support clear water, diverse and abundant beds of submerged aquatic plants, and medium levels of nutrients. Lake St. Clair is classified as oligotrophic to mesotrophic, though limited areas (including those near the Clinton River outlet), can be eutrophic.

Full body contact restrictions (including beach closings) occasionally occur in the study area due to sewage discharges and illicit discharges and spills. Other sources of pollution include discharges from industrial facilities, waste management sites, businesses, agricultural land and animal feedlots, and on-site disposal systems. Based on *Lake St. Clair Water Quality Assessment* data, the Salt River and Crapau Creek sampling locations have routinely exceeded the daily maximum and 30-day geometric mean E. coli standards throughout the monitoring period in Macomb County. In St. Clair County, the standards for total body contact recreation were exceeded in the Harsens Island Main Drain at the North Channel the Marine City Dredge Cut, and the waterway at Golf Course Lane and Cottage Lane on Harsens Island.

Calcium carbonate ($CaCO_3$) alkalinity describes the capacity of a waterbody to resist changes in pH that would result in increased acidity of the water. This capacity is also referred to as buffering capacity. Alkalinity is important for fish and aquatic life because it protects or buffers against rapid changes in pH. Aquatic macroinvertebrates and fish of Michigan inland lakes live best within a pH ranging from 6.0 to 9.0. Higher alkalinity levels in surface waters will prevent large changes in pH that are harmful to aquatic life. For protection of aquatic life, a buffering capacity of at least 20 mg/L is optimal. In general, the lakes within the study area are well buffered (Crawford, 2010).

Sediments quality sampling within Anchor Bay and Lake St. Clair has been limited; however, some of the existing data indicates that the concentrations of pollutants within sediments are high, very probably due to the historic deposition. The United States Geological Survey report on the *Areal Distribution and Concentration of Contaminants of Concern in Surficial Streambed and Lakebed Sediments, Lake Erie-Lake Saint Clair Drainages, 1990-97*, indicates that sediment in the Anchor Bay area exceeds Threshold Effect Levels (TEL) and/or Probable Effect levels for: chlordane, DDT, hexachlorocyclohexane, PCB, Polyaromatic Hydrocarbons, Benzanthracene, Benzopyrene, Chrysene, Phenathrene, arsenic, cadmium, copper, lead, mercury, and zinc. This indicates that there is a potential for food chain bioaccumulation within the watershed.

Recreation

The study area's rivers, lakes and wetlands contribute an abundance of water-based recreation opportunities. These include swimming, boating, and fishing, as well as complementary activities such as picnicking, hiking, bicycling and nature observation. Numerous marinas, boat launches and fishing areas are located along Lake St. Clair and inland lakes and streams. The study area offers access to a broad range of parks, open space, trails, rivers, lakes, wetlands, diverse ecosystems, and recreational facilities. Multiagency collaboration has led to significant efforts in the development of non-motorized trails linking the recreational opportunities for communities in the study area.

The communities in the study area maintain recreational resources that include parks and trail systems. A summary of recreational trails is provided in Table 6. Brief descriptions of major recreation facilities follow.

Table 6: Major Recreation Trails in Study Area

Trail System	Subwatershed	Approximate Length
Bridge to Bay Trail	Anchor Bay	17 mi
Macomb Orchard Trail	Clinton River East, North Branch	27 mi
Stony to MetroBeach Trail	Clinton River East	20 mi

Macomb County Parks and Recreation

Macomb County offers an array of recreational opportunities, particularly its access to inland lakes and Lake St. Clair. Macomb County is home to more than 130 parks covering 12,000 acres managed by state, regional, county, and local governments. Major facilities in Macomb County featuring aquatic recreation are described below:

Macomb Orchard Trail

The Macomb Orchard Trail is a regional non-motorized path that will serve Shelby, Washington, Bruce, Armada, and Richmond Townships within the study area in northern Macomb County. When complete, this trail will follow an old Canadian National Railroad right of way that connects these communities with the Clinton River and Paint Creek Trail in Oakland County.

Stony To MetroBeach Trail

A continuous trail and greenway along Clinton River and Metropolitan Parkway, this trail connects open spaces and parks along the Clinton River between the Stony Creek MetroPark in Washington Township and Metro Beach MetroPark in Harrison Township.

Metro Beach MetroPark

The 770-acre Metro Beach offers 1.25 miles of Lake St. Clair frontage. Facilities include a large lake beach area, swimming pool with water slides, "Squirt Zone" spray park, tot lot and play areas, picnic areas and shelters, three marinas, day sail area, nature center, a nature interpretive area, a paved hike/bike trail, boat launch, an 18-hole par 3 golf course and an 18-hole adventure golf course. An open-air pavilion offers day and evening concerts during the summer months. In the winter, park users enjoy ice-fishing, ice skating, and cross-country skiing.

Stony Creek MetroPark

Built around the 500-acre Stony Creek Lake in gently rolling terrain, this 4,461-acre park offers many recreational activities, including nine large picnic areas, an 18-hole championship golf course, nature center, a nature interpretive area, 24-hole disc golf course, two swimming beaches, play areas, boat launch, and boat rentals. Winter visitors can enjoy cross-country skiing, sledding, and ice-skating.

St. Clair County Parks and Recreation

Similar to Macomb County, opportunities for recreation in St. Clair County are highlighted by rivers, lakes and wetlands that offer a well-balanced mix between active and passive recreational uses. Water-based recreational activities throughout the study area include swimming, boating, and fishing while surrounding areas to the water are complimentary in providing for scenic picnicking, hiking, biking and related activities. State, county, local and regional agencies often collaborate in developing recreational opportunities, such as the development and promotion of the Bridge to Bay Trail, a proposed 50 mile trail extending from the Blue Water Bridge in Port Huron to the shoreline of Lake St. Clair in the Anchor Bay subwatershed.

Habitat

Habitat descriptions at the broadest scale in the U.S. are based on Major Land Resource Areas (MLRAs). MLRAs are geographically associated land resource units, usually encompassing several thousand acres, characterized by a particular pattern of soils, geology, climate, water resources, and land use (USDA NRCS, 2006). The study area is located in the Erie-Huron Lake Plain MLRA (MLRA 99). This MLRA is designated for all six subwatersheds (10-digit Hydrologic Unit Code Boundaries) in the study area.

The Erie-Huron Lake Plain supports broadleaf deciduous forests. Bitternut hickory, shagbark hickory, white oak, red oak, and black oak are the dominant tree species. Red maple, white ash, American basswood, and quaking aspen are dominant on the wetter soils. Some of the major wildlife species in this area are raccoon, rabbit, squirrel, pheasant, and quail. Major resource concerns include loss of habitat for fish and wildlife, and are being addressed via conservation practices that include riparian forest buffers, nutrient management, protection of streambanks and shorelines, and management of upland and wetland wildlife habitat.

The predominant patterns of land development and agricultural cultivation in the study area continue to threaten aquatic organisms and other wildlife populations through degradation, fragmentation and outright destruction of natural habitat. However, the study area provides important habitat for many rare species, with the most abundant being wooded areas. In addition, the study area features extensive aquatic habitat, given the numerous rivers, streams and lakes, including Lake St. Clair (2008 *Clinton River Area of Concern Restoration Plan Update).*

The coastal areas of Lake St. Clair present a special set of habitat conditions and concerns in the study area. Habitat within 10 miles of the lakeshore is highly altered from its presettlement state. Prior to European settlement, the entire lakeshore was dominated by wetlands; now up to 80% of those wetlands have been destroyed or highly degraded according to the *Lake St. Clair Coastal Habitat Assessment* prepared by the Great Lakes Commission in 2006. The remaining emergent wetlands, inland marshes and wet prairies are highly productive of bacterial, insect, plant, avian and animal life and provide spawning grounds for fish. These areas provide habitat for numerous species, including rare species such as black-crowned night heron, Blanding's turtle, lake cress and wild rice. More than 65 species of fish live in Lake St. Clair and the surrounding coastal habitat, notably yellow perch, lake sturgeon, and spottail shiner.

Invasive Species

Invasive species are a concern for nearly all habitat types within the study area. Since the 1800s, more than 160 aquatic invasive organisms, including plants, fish, algae, and mollusks, have established themselves in the Great Lakes Basin. Among others, predominant species of concern within the watershed include zebra mussels, purple loosestrife, and phragmites.

The presence of the zebra mussel was first documented in North America in Lake St. Clair in 1986. Native to Eurasia, the zebra mussel was introduced into the Great Lakes system via ballast water of ocean-going commercial vessels. It has subsequently reduced plankton populations, suspended matter and dissolved oxygen; increased soluble phosphorus and ammonia nitrogen; shifted macrophyte distribution; and clogged municipal water intakes.

Purple loosestrife is commonly found in wetlands and tolerates a wide range of soil types. It can out-compete native vegetation and displace native plants, thereby reducing biodiversity, altering the hydrology of the wetland, and eliminating food and shelter for fish and wildlife. It is a widespread and serious problem, and continues to invade and thrive in wetlands within the study area.

Phragmites is a very aggressive, perennial wetland grass that ranges in height from three to 13 feet. It is a significant concern within the study area, as it negatively impacts both coastal and inland wetlands by crowding out most non-woody native wetland plants that may be important foods for native wildlife and fish.

Other invasive species of concern in the study area include the round goby, spiny water flea, sea lamprey, Eurasian water milfoil, and reed canary grass.

Implementation of 1970 Red Run Drain Study Recommendations

In 1970, the USACE completed a study addressing "flood control, major drainage and allied water use problems in the lower portion of the Clinton River and the Red Run Drain, Michigan." A review of the report associated with that study, published as House Document 431, 91st Congress, 2nd Session, was conducted to determine whether modifications to the recommendations contained therein are advisable at the present time in the interest of flood protection, environmental restoration and protection, recreation and related purposes for the Clinton River and Anchor Bay watersheds.

The 1970 Red Run Drain study addressed the long-term needs of the areas surrounding the Red Run Drain, Lower Clinton River, and Cut-Off Canal system for protection against floods, wise use of the floodplain lands, improvements of the navigation facilities, water supplies for industrial and municipal purposes, outdoor recreational facilities, the enhancement and control of water quality, and related purposes. The improvements recommended in the study were designed to encourage and support the optimum long-range economic development of the region and to enhance the welfare of the people.

The recommendations of the 1970 study included:

1. Enlarge and pave the Red Run Drain for major drainage purposes, except for the portion in Oakland County, which was recommended for abandonment;

2. Enlarge and provide a natural floodway for the Clinton River from its confluence with the Red Run Drain to the Moravian Drive Bridge;

3. Enlarge and pave the Clinton River from the Moravian Drive Bridge through the Cut-Off Canal;

4. General recreation development of a bike-hike trail, picnic areas, playfields, a nature study center, a canoe rental station, rest stops, and ice skating rinks;

5. Construct a small boats lock for recreational craft at the Clinton River Cut-Off Canal; and

6. Construct a boat launching ramp adjacent to the Clinton River Cut-Off Canal.

After review of the current conditions within the 1970 report study area, it has been concluded that recommendations (5) and (6) have been implemented. Recommendation (4) is general in nature, making it difficult to determine the extent to which it has been implemented, if at all. Evidence of the implementation of recommendations (1), (2), and (3), based on current conditions within the watershed could not be directly ascertained. The current conditions within the Red Run Drain and Lower Clinton River include a natural watercourse, with channelization in some areas. Concrete channelization is not present in these areas. Priorities and identified problems and opportunities in in the study area have changed since this report was drafted, and the recommendations in the 1970 Red Run Drain Study are not advisable for further implementation at the present time in the interest of flood protection, environmental restoration and protection, and recreation and related purposes.

5a (2) Future Without-Project Conditions

Land use in the study area is characterized by urban development with some remaining open, wooded and agricultural uses. This mix is expected to remain essentially unchanged for the foreseeable future, with a slow increase in developed areas, particularly for residential uses. Population in the study area is expected to grow, but at the modest rate of approximately 0.4% annually through 2035. However, the number of households is expected to grow at a faster pace of 2.9% yearly. Although pressures from high rates of population growth are not likely to be a significant factor in exacerbating water resource problems within the region, the study area is likely to see increased development and the watersheds exhibit persistent impairments with water quality, ecosystem degradation and restrictions on water-based recreation.

Without actions to address these impairments, it is not expected that conditions will improve, but rather continue to degrade as urban growth continues.

The direct and indirect effects of land development have been identified as the largest contributor to the river's decline within the urbanizing sections Clinton River Watershed. The associated increase in impervious area within the watershed has resulted in greater instability in the river. This instability, if not addressed, will lead to increasing soil erosion, continued deterioration of the river habitat, and increased flood risk both locally and regionally.

Climate change impacts within the basin are anticipated to primarily concern further-altered (flashier) hydrologic conditions within the basin, and potential biodiversity loss. Anticipated responses include less-frequent but more intense warm-weather precipitation events, severely reduced summer low-flow conditions and degraded water quality, less winter ice cover and more cold-weather erosion issues. Riparian habitats may change character and milder climate invasive species may migrate into the area; the exact impacts are not currently known, but would be adaptively managed in the non-federal sponsors O&M work. A primary goal of restoration activities within the Clinton River basin is to develop measures that consider these potential climate change impacts and would be tolerant to a wider range of conditions. Additional steps may need to be taken to provide more robust natural bank protection, runoff retention ponds and buffer strips to reduce sedimentation and contaminant loading.

Without actions that target identified beneficial use problems that are developed sensitive to climate change, the study area will remain as one of the most highly degraded areas within the Great Lakes Basin. If practices remain as they are now, the watershed will continue to see loss of wetlands, erosion of streambanks, loss of aquatic habitat, limitations on recreation and other BUI's identified in the planning documents cited in Section 4. These conditions are likely to lead to further loss of aquatic species diversity and abundance.

Some actions are being undertaken by local agencies to improve ecosystem conditions. These include fish stocking in the Clinton River and efforts to locate and eliminate illicit connections to the storm sewer systems in both Macomb and St. Clair Counties. These actions are beneficial to habitat conditions, but do not address the systemic problems affecting ecosystems in the Clinton River Watershed.

5a (3) Problems (or Needs) and Opportunities

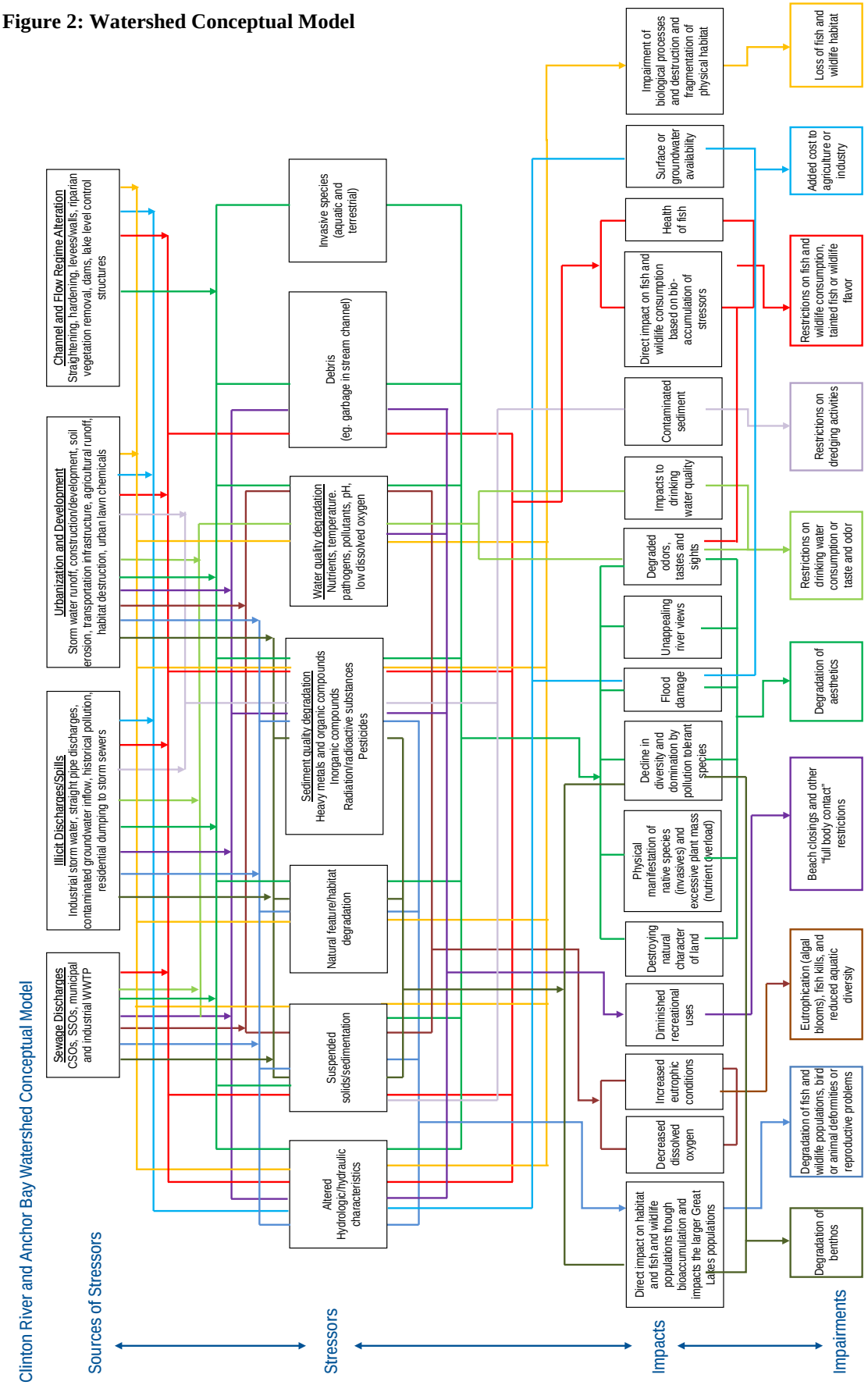
Water resource problems in the Clinton River and Anchor Bay Watersheds are typical of areas with significant urbanized and agricultural land uses. Major causes of water quality degradation, ecosystem degradation and limitations on recreational uses include sewage discharges, illicit connections and discharges, non-point source pollution due to urban and agricultural run-off, and channel and flow regime alteration. This section summarizes the key problems facing the watersheds, along with opportunities to restore and protect ecosystems and address key impairments.

Watershed Conceptual Model

A Watershed Conceptual Model for the Clinton River and Anchor Bay Watersheds, shown in Figure 2, was created to graphically depict and describe the relationship between pollutant sources, stressors, impacts and beneficial use impairments. The beneficial use impairments are those identified as being of medium to high concern in the Remedial Action Plans for the Clinton River Watershed and management plans for the Lake St. Clair Direct Drainage and Anchor Bay Watersheds. The colored lines allow the reader to trace backward from any Beneficial Use Impairment to the stressors and sources that impact it. The multiple connecting lines graphically illustrate the complexity of relationships between sources of stressors and impairments in urbanized watersheds. Sources of stressors include sewage discharges, illicit discharges and spills, urbanization and nonpoint pollution, and channel/flow regime alteration. Each pollutant or pollution source contributes to multiple stressors, impacts and impairments. The colored lines demonstrate how stressors relate to impacts, and impacts relate to impairments.

The primary sources contributing to degradation in the watershed are common occurrences in many other larger urbanized areas of the United States, and reflect the impacts of infrastructure necessary to support a large human population in an urban and suburban setting. These impacts include physical changes to the river such as channelization, flow regime changes, hardening and damming. These physical changes impact the quality, diversity and availability of habitat and, in some cases, may degrade water quality. Physical changes to the landscape also contribute to chemical impacts to the rivers, streams and other surface water bodies that may include nutrients, sediments and toxic compounds that compromise the watershed's ability to support a diverse population of aquatic and terrestrial life, as well as to direct use by the human population. In addition to the physical impacts of increased sedimentation, chemical impacts may cause restrictions on dredging activity.

Figure 2: Watershed Conceptual Model



Problems

Ecosystem degradation in the Clinton River and Anchor Bay Watersheds has been caused, in part, by continuing erosion problems at various locations along waterways. Broad support has been voiced by stakeholders for actions to restore and enhance ecosystems and to address bank stabilization. Other issues in the watersheds reflect the types of long-term degradation often associated with urbanized watersheds. Development has reduced the water-holding capacity of the landscape and altered natural flow dynamics (i.e. intensity, duration, and frequency) in the river system. As a result, the habitat suitability and ecological complexity of the waterways have been moderately impaired. Increased flows will continue to degrade in-stream habitat and increase erosion, thereby causing further sediment deposition. The open water areas of the watershed – particularly near-shore areas of Lake St. Clair – face specific issues such as storm wave-induced shoreline erosion, invasive species and reduced water quality due to non-point source pollution.

The following issues of particular concern have been identified:

- *Habitat Fragmentation and Loss.* Degradation, fragmentation and destruction of natural habitat due to human activity are threats to wildlife populations. Large areas of the watershed have been converted to agriculture as well as urban and suburban residential development uses. In addition, draining and filling of wetlands has deleterious implications for many species. Terrestrial and wetland habitats that are still available may be degraded by air and water pollution or bisected by roadways. Filling of wetlands and alterations to the natural hydrologic system has also affected fish spawning and waterfowl nesting habitat. This problem is related to the following identified BUIs in the study area: degradation of aesthetics, degradation of fish and wildlife populations, and loss of fish and wildlife habitat.

- *Streambank Erosion.* Observations indicate that streambanks along much of the rivers and streams in the study area are subject to high levels of erosion, particularly during storm events. Continued erosion within these areas (particularly those characterized as moderate or severe), will result in further degradation of the streambed and water quality through increased turbidity and temperature, coupled with decreased dissolved oxygen levels. In addition, excess sediment loads will reduce habitat suitability of the streambed for aquatic macroinvertebrates and fish. This problem is related to the following identified BUIs the study area: degradation of aesthetics, loss of fish and wildlife habitat, and degradation of benthos.

- *Nonpoint Source Pollution and Water Quality.* While water quality has generally improved in many portions of the watershed in recent decades, significant problems do remain. Nutrient and bacteria loading due to municipal and industrial discharges, runoff, combined sewer overflows and contaminated sediments (primarily in tributaries and canals along Lake St. Clair) results in pollutant increases (bacteria, heavy metals, toxic organics) that cause beach closings and other health-related issues. In addition, illicit connections are present in the study area; both Macomb and St. Clair Counties are implementing programs to identify and eliminate them. Nonpoint source pollution related to increased development and impervious surfaces is typical of urbanized watersheds. This problem is related to the following identified BUIs in the study area: degradation of fish and wildlife populations, loss of fish and wildlife habitat, degradation of benthos, eutrophication, beach closings, restrictions on fish and wildlife consumption, and restrictions on drinking water consumption.

- *Invasive Species.* As noted above, the introduction of invasive aquatic and terrestrial species of plant and animal life has disrupted watershed habitat and ecosystems. This problem is related to the following identified BUIs in the study area: degradation of aesthetics, degradation of fish and wildlife populations, and loss of fish and wildlife habitat.

- *Flooding* has been an historical problem in the study area as well, exacerbated over time by development and the associated loss of pervious surfaces and alteration of natural hydrological patterns. Ecosystem degradation – particularly the capacity of the landscape to infiltrate and hold water – is directly related to flood risk.

Opportunities

Based on the key water resource problems identified, a number of overarching opportunities were developed. These opportunities will be used to assess the ability of potential projects to meet the most pressing water resource needs in the Clinton River and Anchor Bay Watersheds.

- Improve aquatic and terrestrial habitat by restoring wetland, riparian and lacustrine ecosystems. This will enhance biodiversity and native populations by creating a net increase in habitat, by improving existing habitat quality and removing obstructions to aquatic and terrestrial organism movement. This opportunity is related to the following identified BUIs in the study area: degradation of aesthetics, degradation of fish and wildlife populations, and loss of fish and wildlife habitat.

- Identify potential retention areas to hold stormwater and to be used for nesting of migratory birds and fish spawning. Remove dams and/or provide fish passage structures to limit aquatic habitat fragmentation and mitigate water quality impacts. This will result in an increase in available habitat for aquatic species. This opportunity is related to the following identified BUIs in the study area: degradation of fish and wildlife populations, loss of fish and wildlife habitat, and degradation of benthos.

- Improve sediment and water quality by reducing sources contributing to existing problems. This may include point and nonpoint source reduction and cleanup of contaminated sites, as well as streambank stabilization. This opportunity is related to the following identified BUIs in the study area: degradation of fish and wildlife populations, loss of fish and wildlife habitat, degradation of benthos, eutrophication, restrictions on dredging activity, and beach closings.

- Implement measures to control, remove or reduce the distribution of invasive species. This opportunity is related to the following identified BUIs in the study area: degradation of aesthetics, degradation of fish and wildlife populations, and loss of fish and wildlife habitat.

5b. Project Identification and Preliminary Screening

Potential projects in the study area were compiled from input provided by numerous regional entities and stakeholder groups. Project identification was closely aligned with larger watershed and ecosystem restoration planning underway in the study area. In particular, the planning team worked with SEMCOG and the Lake St. Clair/St. Clair River Protection and Restoration Partnership. The Partnership is the coalition of Federal, State, Regional, Municipal agencies and non-governmental organizations responsible for implementing the St. Clair River and Lake St. Clair Comprehensive Management Plan (CMP).

The Partnership's Strategic Implementation Plan (SIP), which sought to identify potential projects to further the objectives of the CMP, was undertaken simultaneously with this Reconnaissance study, and the two processes were closely coordinated. The Partnership organized stakeholder workshops to identify key water resource project of benefit to both plans, and to ensure that well-supported projects were developed and considered for funding support.

The SIP process resulted in stakeholders submitting more than 70 potential projects to address water resource problems in an area that included the study area for this Reconnaissance Study. Working with the Partnership, the study team conducted an initial screening of those projects to determine those with locations within the Clinton River or Anchor Bay watersheds. This initial screening left 59 projects to be

reviewed for the Corps development of fact sheets. In addition, 20 projects identified in the Lower Clinton/Anchor Bay Reconnaissance Study literature review and nine projects in the Upper Clinton watershed reconnaissance study were incorporated into the next screening phase, for a total of 88 projects identified for consideration.

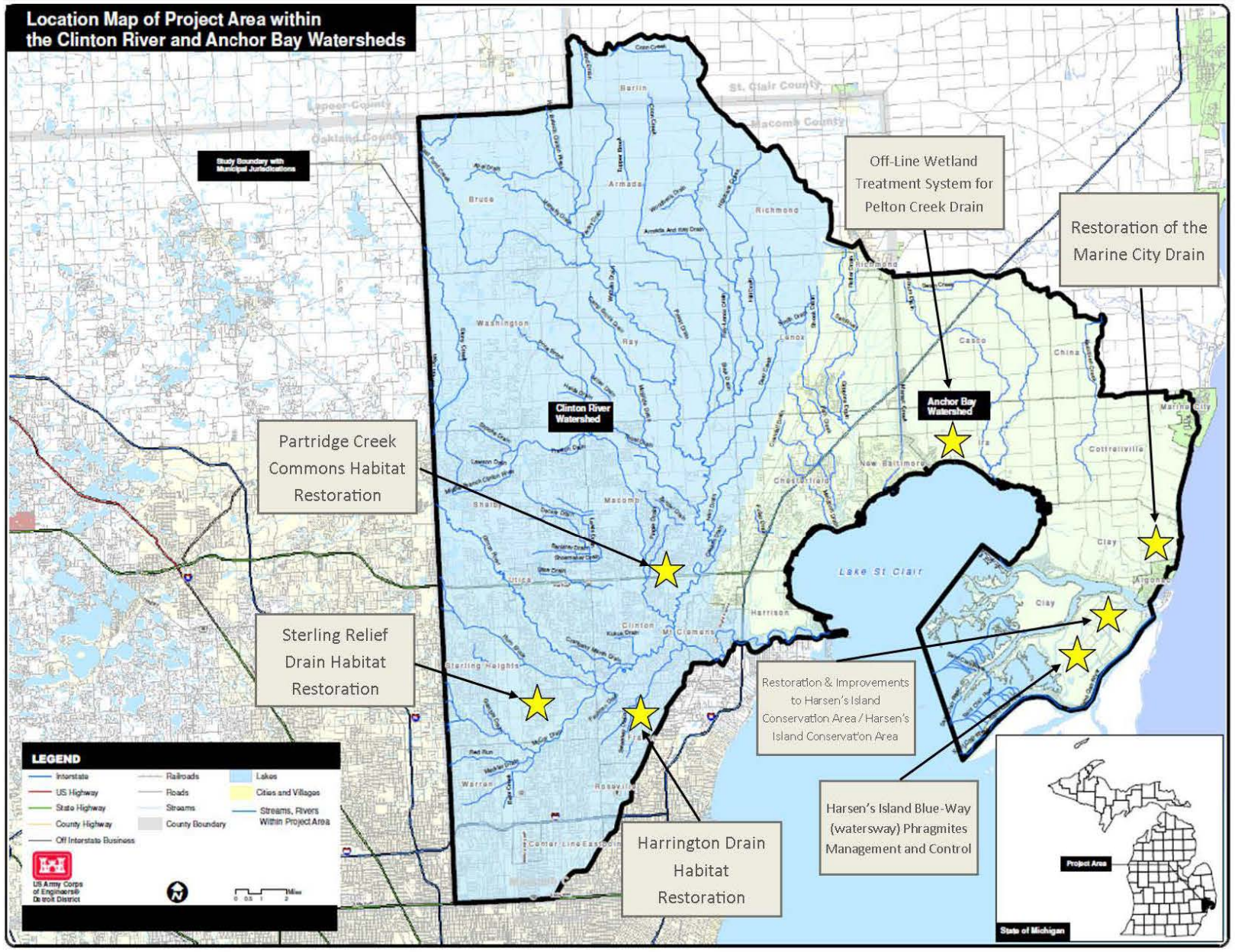
Those projects were further screened to identify those that appeared to fit under Corps missions for habitat restoration and flood risk management, as well as for detailed location, level of project development, identification of a non-Federal sponsor and other criteria, and were ranked for priority implementation by Partnership members at a final stakeholder workshop. This screening resulted in eight projects being selected for more detailed evaluation in this Reconnaissance Study. Those projects are shown in Table 7. The project number associated with the project names refers to the numbering on the SIP list. A summary of the projects included in the secondary screening is included in Appendix D.

Table 7: Potential Projects in the Lower Clinton and Anchor Bay Watersheds

Project	Problem or Opportunity Addressed	Location	Watershed
Harrington Drain Habitat Restoration (#169)	Habitat conservation and restoration. Storm water management	Clinton and Fraser Townships	Clinton River
Partridge Creek Commons Habitat Restoration (#177)	Habitat conservation and restoration. Storm water management	Clinton Township	Clinton River
Sterling Relief Drain Habitat Restoration (#94)	Habitat conservation and restoration. Storm water management	Sterling Heights	Clinton River
Off-Line Wetland Treatment System for Pelton Creek Drain (#229)	Habitat conservation and restoration. Storm water management	Ira Township	Anchor Bay
Restoration of the Marine City Drain (#232)	Habitat conservation and restoration. Storm water management	Cottrellville Township	Anchor Bay
Restoration and Improvements to Harsen's Island Conservation Area (#141)	Habitat conservation and restoration. Storm water management. Identification and reduction of bacteria	Clay Township	Anchor Bay
Harsen's Island Conservation and Recreation Area (#133)	Habitat conservation and restoration	Clay Township	Anchor Bay
Harsen's Island Blue-Way (watersway) Phragmites Management and Control (#149)	Habitat conservation and restoration	Clay Township	Anchor Bay

Each of these projects is described below, and their locations in the study area are shown in Figure 3. Descriptions are summarized from the SIP project submittal information.

Figure 3: Locations of Potential Projects



Harrington Drain Habitat Restoration

The Harrington Drain is an incised open drain approximately 6 miles in length, draining six square miles in Clinton Township. It discharges to the Clinton River just upstream of Groesbeck Highway. The drain features a clay bed channel with steep banks and excessive erosion that contributes to the turbidity of the lower reaches of the Clinton River. These impacts to water quality, combined with riparian vegetation overrun with invasive species and lacking in understory, are associated with overall degradation of aquatic habitat in the Harrington Drain.

The Harrington Drain Habitat Restoration Project includes an inventory of conditions in the waterway to locate sites of severe erosion, debris jams, and infrastructure problems; the development and implementation of a riparian vegetation management plan to remove invasive species and tree thinning; an assessment of stream morphology to identify causes of channel instability; the development of improvements to four of the highest priority reaches within the Drain to stabilize structures, excavate floodplain, control grades, re-vegetate streambanks and enhance fisheries through improvement of instream conditions for spawning habitat. Secondary reaches will be addressed in a second phase of the project.

Preliminary estimates of benefits include improved water quality and aquatic habitat through the reduction of 750 tons annually of sediment loading and 2.25 tons per year of phosphorus loading. The project will restore six miles of channel habitat and control invasive species over 50 acres. The project as currently developed includes habitat surveys and monitoring and the development of an operations and maintenance plan to identify immediate and long-term procedures for invasive species removal, riparian vegetation, and water quality management practices.

Project Sponsor: Macomb County Public Works Office

Estimated Project Cost: $2.85 million

Estimated costs for each phase of the proposed project are summarized in Table 8.

Table 8: Harrington Drain Habitat Project Proposed Phases and Costs (2011 dollars)

Project Phase	Preliminary Cost Estimate
A. Drain Inventory	$25,000
B1. Riparian Vegetation Management Plan	$45,000
B2. Riparian Vegetation Plan Implementation	$300,000
C1. Assessment of Stream Morphology and Priority Improvement Plan	$290,000
C2. Priority Drain Improvement Implementation	$1,200,000
D1. Secondary Improvement Plan	$190,000
D2. Secondary Drain Improvement Implementation	$800,000
Total	*$2,850,000*

Partridge Creek Commons Habitat Restoration

Partridge Creek Commons is a former public golf course consisting of four parcels totaling 52 acres in area. The project site is located in Clinton Township and is traversed by a linear mile of Gloede Drain. The site includes several discontinuous areas of wetland and historically, upland areas were oak openings. Partridge Creek Commons is restricted by a conservation easement held by Clinton Township, and is considered to have significant potential for restoration in a densely developed area of Macomb County. Invasive terrestrial and wetland plant species are found throughout the site, and the drainage corridor exhibits considerable erosion in some areas.

The plan for habitat restoration on this site involves four phases: Invasive species control and native species restoration; floodplain restoration of 5,500 feet Gloede Drain to manage stormwater with channel meeting county open drain standards; wetlands restoration of up to five acres with hydrologic connections re-established between floodplain, wetlands and upland pocket (non-contiguous) wetlands; oak opening restoration and recreation facility development featuring trails utilizing golf cart path infrastructure and interpretive signage.

Preliminary estimates of project benefits include 52 acres of restored wetland, upland and aquatic habitat; 5,500 lineal feet of multi-staged open channel restoration; five acres of restored wetlands; improved recreation opportunities. The project as currently developed includes habitat surveys, monitoring of pre- and post-project conditions for benthic organisms, fish and vegetation, and the development of an operations and maintenance plan to identify immediate and long-term procedures for invasive species removal, riparian vegetation, and water quality management practices.

Project Sponsor: Macomb County Public Works Office

Estimated Project Cost: $4.98 million

Estimated costs for the proposed project are summarized in Table 9.

Table 9: Partridge Creek Commons Habitat Project Proposed Phases and Costs (2011 dollars)

Project Phase	Preliminary Cost Estimate
A. Invasive Species Control	$450,000
B. Gloede Drain Restoration	$1,750,000
C. Wetland Restoration	$250,000
D. Oak Opening (Upland Habitat) Restoration	$2,525,000
Total	*$4,975,000*

Sterling Relief Drain Habitat Restoration

The Sterling Relief Drain is approximately five (5) miles in length and is located between 15 Mile Road and 16 Mile Road, extending from just west of Ryan Road to its confluence with the Red Run Drain just east of Schoenherr Road. The Sterling Relief Drain was constructed in 1970 by the MCPWO and was extended in 1976. The drain was installed to meet the needs of the land development within its district and to intercept the flows from areas previously served by the Big Beaver Creek. Since initial construction, dramatic development and urbanization within the Red Run Subwatershed have increased runoff and pollutant transfer to its tributaries.

The proposed project will consist of seven phases: Construction of a new open channel to replace over 2,000 feet of enclosed storm sewer within the Sterling Relief Drain; removal of a perched outfall directly connected to the Red Run Drain, which will restore approximately five (5) miles of drain connectivity; creation of 2.5 acres of riparian floodplain habitat; creation of over 10,000 square feet of spawning habitat; development of a long-term native vegetation management plan to control invasive species and establish native plant buffers; enhancement of recreation through pedestrian trail-way and river accessibility; and replacement of turf grass with native vegetation.

Preliminary estimates of project benefits include 2.5 acres of created riparian floodplain habitat; 10,000 square feet of restored spawning habitat; 2,000 lineal feet of open channel restoration; 5 miles of restored drain connectivity; and improved recreation opportunities. The project, as currently developed, includes monitoring of pre- and post-project conditions for benthic organisms, fish and vegetation, and the development of an operations and maintenance plan to identify immediate and long-term procedures for invasive species removal, riparian vegetation, and water quality management practices.

Project Sponsor: Macomb County Public Works Office

Estimated Project Cost: $1.5 million

Off-Line Wetland Treatment System for Pelton Creek Drain

The Pelton Creek Drain runs along 26 Mile Road in the east-west direction and Church Road in the north-south direction. The current condition and location of the proposed project area consists of rural farmland in Ira Township approximately two miles north of Anchor Bay.

The proposed project will consist of constructing a wetland treatment habitat and pond approximately 19 acres in area by re-routing the Pelton Creek Drain away from the road. This new wetland area will provide storm water retention, promote infiltration, reduce storm water runoff volume, and treat and remove sediment and nutrients from the storm water. It will also include restoration and creation of 11 acres of riparian wetland habitat to reduce the storm water runoff volumes and filter sediment and nutrients.

Project Sponsor: St. Clair County Drain Office

Estimated Project Cost: $700,000

Restoration of the Marine City Drain

The Marine City Drain discharges to the St. Clair River in Clay Township in the City of Algonac, just upstream of the St. Clair River's confluence with Lake St. Clair. Currently, the drain prevents fish passage due to barriers and debris dams throughout the length of the drain.

The proposed project will address habitat fragmentation through the removal of six miles of fish passage barriers, such as sediment blockage and debris dams. The project will create and restore habitat for resident and migratory populations of fish, birds, and other aquatic wildlife. Invasive species will be controlled on three miles of stream corridor and six miles of riparian zones and in-stream habitat will be restored through plantings.

Preliminary estimates of project benefits include 6 miles of restored riparian floodplain habitat; 6 miles of restored drain connectivity; and 3 miles of invasive species control.

Project Sponsor: St. Clair County Drain Office

Estimated Project Cost: $1.5 million

Restoration and Improvements to Harsen's Island Conservation Area

The Harsen's Island Conservation and Recreation Area is located on Harsen's Island within Clay Township. The land is bordered by Stewart Road on the north, Krispin Road on the south, M-154 on the east, and Golf Course Road on the west. This area includes trails for hiking and biking, water trails for canoeing, kayaking, and fishing, as well as opportunities for bird-watching, picnicking, hunting and other outdoor activities.

The proposed project will include restoration of lakeplain prarie, grooming and marking of approximately five (5) miles of trails, treatment and control of invasive species, and expansion of educational and interpretive programs.

Project Sponsor: Harsen's Island Conservation Association Incorporated

Estimated Project Cost: $1.0 million

Harsen's Island Conservation and Recreation Area

The Harsen's Island Hunt Club consists of 440 acres within Harsens Island that surrounds the Stewart Farm Ecology Center. The ecological components of the project area consists of approximately 50 acres of Great Lakes Marsh, 50 acres of wet-prairie, 125 acres of wet-mesic prairie, and 120 acres of wet-mesic flatwoods and oak opening. In recent years, this land has been at high risk for development.

The proposed project involves acquisition of the 440 acre Hunt Club lands. This acquisition of this land would allow for continued protection from development and the opportunity for restoration through the removal of invasive species. It has been projected that this protection and preservation would avoid 500 to 600 residential septic systems from contaminating the area.

Project Sponsor: Harsen's Island Conservation Association Incorporated

Estimated Project Cost: $8.0 million

Harsen's Island Blue-Way Phragmites Management and Control

The Harsen's Island Conservation and Recreation Area is located on Harsen's Island within Clay Township. The land is bordered by Stewart Road on the north, Krispin Road on the south, M-154 on the east, and Golf Course Road on the west. This area includes trails for hiking and biking, water trails for canoeing, kayaking, and fishing, as well as opportunities for bird-watching, picnicking, hunting and other outdoor activities.

This project consists of a two year program to eliminate the invasive species Phragmites from blue-way, or waterways, on Harsen's Island. This elimination of invasive species would allow for development of eco-tourism opportunities, and for fish and wildlife habitat.

Preliminary estimates of project benefits include over three miles of riparian waterway improvements to provide recreation opportunities, along with fish and wildlife habitat. Once controlled, Phragmites will be managed by the Clay Township Phragmites Management Advisory Board via private landowner participation.

Project Sponsor: Clay Township Phragmites Management Advisory Board

Estimated Project Cost: $500,000

5c. Preliminary Evaluation of Projects

Table 10 summarizes the preliminary evaluation of the proposed projects for their ability to meet Federal Interest for habitat restoration and other primary missions of the USACE. Habitat restoration benefits are represented by linear feet of streambank stabilization (where applicable). As described later in this section, many of the proposed projects feature additional environmental benefits in that they reduce sediment loading, reestablish natural hydrologic regimes, improve terrestrial habitat, remove obstructions to the movement of aquatic organisms or create/enhance opportunities for recreation.

Table 10: Preliminary Evaluation of Projects

Project	Preliminary Project Cost Estimate	Habitat Restoration and Other Ecological Benefits
Harrington Drain Habitat Restoration	$2.85 million	6 miles of channel restoration 50 acres invasive species control 750 tons/year sediment reduction 2.25 tons/year phosphorus reduction
Partridge Creek Commons Habitat Restoration	$4.98 million ($2.45 million for water-resources related project tasks)	5,500 feet of channel restoration 5 acres wetland restoration
Sterling Relief Drain Habitat Restoration	$1.5 million	2,000 feet of channel restoration Restore 5 miles of drain connectivity 2.5 acres riparian habitat restoration
Off-Line Wetland Treatment System for Pelton Creek Drain	$700,000	19 acres wetland habitat creation 11 acres wetland habitat restoration Sediment loading reduction
Restoration of the Marine City Drain	$1.5 million	6 miles of riparian habitat restoration 6 miles enhancements to fish passage 3 linear miles invasive species control
Restoration and Improvements to Harsen's Island Conservation Area	$1.0 million	Invasive species control
Harsen's Island Conservation and Recreation Area	$8.0 million	Invasive species control
Harsen's Island Blue-Way Phragmites Management and Control	$500,000	3 miles of riparian habitat improvement Invasive species control

As noted, many of these proposed projects will improve fish and wildlife biodiversity and populations through a net increase in aquatic and terrestrial habitat, improved habitat quality (including improved water quality) and the removal of obstructions to the movement of aquatic organisms. Such enhancements may be quantified with the use of Habitat Suitability Index methodologies or similar metrics. In addition, some of these projects also will yield ancillary benefits in the form of improving recreation opportunities,

flood risk management. The remainder of this section evaluates each project for these benefits and their ability to address USACE missions.

- Harrington Drain Habitat Restoration

  This project would produce environmental restoration benefits measurable in linear feet of streambank stabilization and riparian habitat restoration. This will result in a net increase in both the quantity and quality of aquatic and related terrestrial habitat. Furthermore, this project is likely to improve water quality in the Clinton River watershed by reducing sediment and nutrient loadings, and control invasive species over a 50 acre area, thus reducing disruptions to native ecosystems. Preliminary cost estimates anticipate the project could be completed for approximately $90 per linear foot of improved streambank.

  Pending a Determination of Federal Interest (DFI), this project is recommended for a feasibility phase analysis based on its potential for significant environmental restoration benefits.

- Partridge Creek Commons Habitat Restoration

  This project would produce environmental restoration benefits measurable in linear feet of streambank stabilization and riparian habitat restoration. This will result in a net increase in both the quantity and quality of aquatic and related terrestrial habitat. Furthermore, this project is likely to improve water quality in the Clinton River watershed by reducing sediment loadings, and control invasive species over a 50 acre area, thus reducing disruptions to native ecosystems. Additionally, this project is designed to restore a 5-acre wetland and reestablish severed hydrologic connections, and may thereby improve flood risk management in this area of Macomb County.

  As detailed in Table 9, the project cost estimates includes $2.53 million for restoration of upland (non-aquatic) habitat. The preliminary water resource improvement line items in the budget total an estimated $2.45 million, of which an estimated $1.75 million is directed toward stream restoration. This would equate to an estimated $318 per linear foot of improved waterway.

  Pending a DFI, the water resources elements of this project – tasks A, B and C in Table 9 – are recommended for a feasibility phase analysis based on their potential for significant environmental restoration benefits. These elements of the proposed project are likely to have benefits that accrue throughout the watershed. The upland habitat restoration elements are not recommended for a feasibility phase analysis as the benefits thereof are not estimated to directly improved water resources.

- Sterling Relief Drain Habitat Restoration

  This project would produce environmental restoration benefits measurable in linear feet of streambank stabilization and riparian habitat restoration. This will result in a net increase in both the quantity and quality of aquatic and related terrestrial habitat. Furthermore, by opening a waterway that is currently enclosed in a culvert the project will enhance movement of aquatic organisms and open up five miles of the drain system to fish passage and open 10,000 square feet of area to fish spawning; it will control invasive species and enhance recreation opportunities. Preliminary cost estimates anticipate the project could be completed for approximately $75 per linear foot of improved streambank.

  Pending a DFI, this project is recommended for a feasibility phase analysis based on its potential for significant environmental restoration benefits.

- Off-line Wetland Treatment System for Pelton Creek Drain

  This project would produce environmental restoration benefits measurable in acres of wetland habitat creation. This will result in a net increase in both the quantity and quality of aquatic and related terrestrial habitat. Furthermore, this project is likely to improve water quality in the Anchor Bay watershed by reducing sediment and nutrient loadings, and to provide flood risk management benefits. Preliminary cost estimates anticipate the project could be completed for approximately $23,300 per acre of restored and created riparian wetland habitat.

  Pending a DFI, this project is recommended for a feasibility phase analysis based on its potential for significant environmental restoration benefits and flood risk management benefits.

- Restoration of Marine City Drain

  This project would produce environmental restoration benefits measurable in linear feet of riparian habitat restoration. This will result in a net increase in both the quantity and quality of aquatic and related terrestrial habitat. Furthermore, by removing barriers to aquatic organism movement, the project will restore fish passage in six miles of stream. The project will also feature control of invasive species and thus reduce disruptions to native ecosystems. Preliminary cost estimates anticipate the project could be completed for approximately $47 per linear foot of restored riparian habitat.

  Pending a DFI, this project is recommended for a feasibility phase analysis based on its potential for significant environmental restoration benefits.

- Restoration and Improvements to Harsen's Island Conservation Area

  This project is focused on improvements to upland terrestrial habitats and to terrestrial recreation facilities, as well as on enhancements to educational programming. Improvements to aquatic habitat are likely to be ancillary, although some improvements to aquatic recreation facilities are proposed. Because the project is not focused on directly improving aquatic habitat or on flood risk management, it is unlikely to meet the thresholds for Federal interest under the mission areas of the USACE.

  This project is not recommended for a feasibility phase analysis based on its potential for environmental restoration or flood risk management benefits.

- Harsen's Island Conservation and Recreation Area

  This project involves purchasing environmentally sensitive land in the Anchor Bay watershed from a private owner, and holding the property as a conservation area. While this action may create benefits for aquatic ecosystems, it does so indirectly, and does not directly increase the quality or quantity of aquatic habitat in the study area. Because the project does not directly increase habitat quality or quantity, it is unlikely to meet thresholds for Federal interest under the mission areas of the USACE.

  This project is not recommended for a feasibility phase analysis based on its potential for environmental restoration management benefits.

- Harsen's Island Blue-Way Phragmites Management and Control

  Phragmites is a major ecosystem problem in the Anchor Bay watershed, as its presence disrupts the native balance of aquatic and terrestrial species, thereby reducing habitat. This project would produce environmental restoration benefits measurable in linear feet of riparian habitat restoration. This will result in a net increase in both the quantity and quality of aquatic and related terrestrial habitat. An ancillary benefit is the improvement of aquatic recreation opportunities in the study area. Preliminary cost estimates anticipate the project could be completed for approximately $32 per linear foot of restored riparian habitat.

  Pending a DFI, this project is recommended for a feasibility phase analysis based on its potential for significant environmental restoration benefits. It should be noted that phragmites control does not represent comprehensive restoration of riparian habitat; there may be opportunities to undertake this project in a more comprehensive manner, and these could be explored in a feasibility analysis.

6. Federal Interest

Federal Interest is established once it is determined that the potential action being considered under the Reconnaissance Study phase falls under one of the Corps' primary mission areas: navigation, flood damage reduction and ecosystem restoration, and that the project benefits outweigh the project costs. Also, a potential willing and capable non-Federal sponsor should be identified for projects to be recommended to proceed to feasibility analysis.

The Corps objective for National Environmental Restoration (NER) is to contribute to the nation's ecosystems through the restoration of significant ecosystem function, structure, and dynamic value with contributions measured by changes in the amounts and values of habitat. Additionally, the proposed projects should also be justifiable based on preliminary analysis of cost versus economic and environmental benefits. Further, the proposed projects should be sensible and be in the public interest.

With the exception of two Harsen's Island projects and one element of the Partridge Creek Commons project, the restoration opportunities described above represent prudent approaches to restoration of degraded aquatic, wetland, and riparian habitat in the Clinton River and Anchor Bay Watersheds. These actions would result in significant ecosystem benefits of local, regional, and national significance. Although a benefit-cost analysis is beyond the scope of this Reconnaissance Study, based on preliminary cost estimates, these project locations demonstrate reasonable and consistent costs typical for their range of environmental outputs. Ecosystem restoration efforts at the proposed project locations would serve the public interest by improving overall conditions in the watershed, contributing to opportunities for aquatic recreation, and enhancing water quality. As noted in Section 7, willing non-Federal partners have been identified for these various projects.

In sum, the six projects listed below meet the criteria for Federal Interest:

- Harrington Drain Habitat Restoration
- Partridge Creek Commons Habitat Restoration, elements A-C
- Sterling Relief Drain Habitat Restoration
- Off-line Wetland Treatment System for Pelton Creek Drain
- Restoration of the Marine City Drain
- Harsen's Island Blue-Way Phragmites Management and Control

As such, these projects should be advanced to feasibility phase. Alternatively, based on cost, some of these projects could be pursued under Section 206 of the Water Resources Development Act of 1996.

They will substantially address the watershed problems identified in this study by restoring aquatic and riparian habitat, reducing habitat fragmentation, increasing species diversity, improving water quality, reducing flood risk, and/or providing enhanced recreation opportunities. Further, they are consistent with other Federal, state and regional planning efforts, and will complement other GLRI-funded projects focused on the Clinton River Watershed and other major tributary systems to the Great Lakes.

A more detailed and precise quantitative evaluation of project benefits will be undertaken during the feasibility phase analysis via the application of Habitat Suitability Index methodologies or similar metrics.

7. Sponsor Intent

The Macomb County Public Works Office has expressed interest in serving as non-Federal sponsor for the Harrington Drain, Partridge Creek and Sterling Relief Drain environmental restoration projects recommended for the feasibility analysis phase.

The St. Clair County Drain Office has expressed interest in serving as non-Federal sponsor for the Pelton Creek and Marine City Drain environmental restoration project recommended for the feasibility analysis phase.

The Clay Township Phragmites Management Board Office has expressed interest in serving as non-Federal sponsor for the Harsen's Island Blue Way Phragmites Management environmental restoration project recommended for the feasibility analysis phase.

These sponsors understand the cost sharing responsibilities associated with both feasibility analyses and project implementation. They also understand their responsibilities for operating and maintaining any such completed projects at 100 percent non-Federal expense

8. Summary of Specific Study Assumptions

Pending a DFI, should the stakeholders and a non-Federal sponsor decide to pursue site-specific feasibility study(ies), the list of assumptions below would be used to guide development of the supporting Project Management Plan (PMP) and schedule for any subsequent feasibility studies.

1. A single feasibility study for each potential ecosystem restoration/flood risk management project in the Clinton River and Anchor Bay Watersheds will be executed, depending on the identification of willing and capable non-Federal sponsor(s) and the availability of Federal funds;

2. The decision document will consist of a Feasibility Study and a National Environmental Policy Act (NEPA) document prepared by the Detroit District;

3. Based on the non-Federal sponsor's fiscal year and budgets, the precise amount of funds available cannot be determined at this time. The study schedule shown in Section 9 may be extended during development of the PMP.

4. An MCASES cost estimate will be performed on any secondary structural and non-structural flood risk management measures that are part of a selected plan. The cost of preliminary alternative structural and nonstructural measures will be developed at a lesser level of detail with comparative cost estimating techniques. The costs for the recommended plan for each feasibility phase estimate will be developed with enough certainty as to be within 20% of the actual project cost;

5. A cost effectiveness and incremental analysis (CE/ICA) will be prepared for ecosystem restoration features. Alternative Plan features which have both ecological as well as traditional economic benefits (such as streambank stabilization using bioengineering techniques) will be evaluated with both CE/ICA and traditional benefit-cost evaluation techniques and integrated in order to evaluate and select the recommended plan;

6. A Benefit-Cost Analysis will be prepared for flood control features, in accordance with the requirements of ER 1105-2-100 (22 April 2000).

9. Feasibility Phase Milestones

A draft schedule of feasibility study milestones will be prepared in conjunction with the development of a PMP. A preliminary list of typical tasks and their estimated duration is presented in Table 11.

Table 11. Feasibility Phase Milestones.

Milestone	Duration in Months
Execute Feasibility Cost Share Agreement	1
Feasibility Study Initiation	2
Notice of Intent	2
Joint Environmental Impact Statement (EIS) /Environmental Impact Report (EIR) Scoping Meeting – Public Workshop	2
Field Investigations	6
Alternative Designs	9
Alternative Formulation and Evaluation	6
Alternative Formulation Report	3
Alternative Formulation Briefing	1
Draft Feasibility Report (DFR), Draft EIS/EIR	3
Comment Period	1
Transmit DFR and DEIS to Division and HQ and distribute to public	1
Comment Period	1
Prepare Final Feasibility Report (FFR) and Final EIS/EIR	2
Transmit FFR and FEIS to Division and HQ	1
Division Commander's Public Notice	2
Total	**Approximately 36 months** (some tasks are performed concurrently)

10. Feasibility Phase Cost Estimate

The costs to complete the Feasibility Studies for the projects detailed in this report will be fully developed as part of the preparation of a PMP. In that process, study costs will be negotiated with the non-Federal sponsor.

11. Recommendations

This investigation has demonstrated a Federal Interest in environmental restoration and associated benefits (e.g., flood risk management measures and improvement in recreation opportunities) in the Clinton River and Anchor Bay Watersheds in Southeast Michigan, as detailed in Section 5c of this report. Viable environmental restoration measures have been provided. It is anticipated that the benefits of such measures will exceed project costs in each of the recommended projects within the study area, resulting in positive contributions to the NER accounts. A Determination of Federal Interest (DFI) will evaluate each project for its ability to provide tangible benefits to a species or habitat of national significance. There is significant local support for environmental restoration, and it is expected that non-Federal project partners will be willing and able to cost share feasibility studies and project implementation. The six projects identified in this reconnaissance report that meet the criteria for Federal Interest are listed below:

- Harrington Drain Habitat Restoration
- Partridge Creek Commons Habitat Restoration, elements A-C
- Sterling Relief Drain Habitat Restoration
- Off-line Wetland Treatment System for Pelton Creek Drain
- Restoration of the Marine City Drain
- Harsen's Island Blue-Way Phragmites Management and Control

These projects, implemented as part of a comprehensive watershed restoration approach, would provide significant ecosystem benefits to the Clinton River/Anchor Bay watershed. As such, this reconnaissance study is a positive report, and it is recommended that the above projects proceed to feasibility. Upon completion of a positive DFI and the identification of a viable a non-Federal sponsor from whom a Letter of Intent is received, the District will request funds to develop a PMP for each identified eligible project(s), and to initiate FCSAs.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority for authorization and/or implementation funding.

12. Views of Other Resource Agencies (if known)

Eighty-four Federal, state, regional, municipal and non-governmental agencies with an interest in water resources in the Clinton River and Anchor Bay watersheds were contacted over the course of this Reconnaissance Study. The scoping letter and responses are included in Appendix C.

13. Issues Affecting Initiation of Feasibility Studies

Constraints represent restrictions that may make achievement of planning objectives more difficult. Constraints identified for this study that may affect outcomes include:

- Initiation of Feasibilities Studies is contingent on a positive Determination of Federal Interest, demonstrating tangible benefits to a species or habitat of national significance.
- Initiation of Feasibility Studies is contingent on identification of a willing and capable non-Federal sponsor beyond the initial commitments identified in Section 7, and may be impacted by that sponsor's fiscal planning cycles.

- Portions of the riparian corridors in the Clinton River and Anchor Bay Watersheds are privately owned. This can make coordination of efforts challenging. Aligning project goals and objectives across a broad range of stakeholders will ease implementation.
- The watersheds lie in multiple counties, townships, and cities, creating potential for jurisdictional friction. Involving local governments in project development will ease implementation.
- The public may not understand the relationships between flood damage, water quality and habitat restoration. Further, the public may not understand both the direct and indirect benefits of any particular project. Developing educational materials in conjunction with projects may be valuable in communicating the range of benefits associated with any particular project.
- Inconsistent Federal funding levels may result in delays in the execution of Feasibility Studies.

14. Project Area Map

A map detailing the project area is shown in Figure 1, page 3.

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Robert J. Ells
Lieutenant Colonel, U.S Army
District Engineer

SUPPLEMENTAL APPENDICES

A. References

B. Scoping Correspondence

C. Project Identification and Initial Screening

D. Source Document Abstracts

Appendix A: References

Anchor Bay Watershed Management Plan, Anchor Bay Technical Committee, 2006

St. Clair River and Lake St. Clair Comprehensive Management Plan, USACE, 2004

Hydrologic and Geomorphic Analysis of the Clinton River Watershed: Final Report, ECT, 2006

Effects of Urban Land-Use Change on Streamflow and Water Quality in Oakland County, Michigan, 1970-2003, as Inferred from Urban Gradient and Temporal Analysis, Aichele, 2005

Anchor Bay Watershed and Management Plan-Volume II-Appendices, Anchor Bay Technical Committee, 2003 Vol II

Clinton River Area of Concern Restoration Plan Update, Tetra Tech, Inc., 2008

Lake St. Clair Coastal Habitat Assessment, Great Lakes Commission, 2006

Appendix B: Scoping Correspondence

Letters were sent to 84 federal and state agencies, municipalities and non-governmental organizations requesting comments and input on this reconnaissance study. A copy of the scoping letter is included below.

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
BOX 1027
DETROIT, MICHIGAN 48231-1027

Recipient Name
Street Address
City/ State/ Zip Code

Date/ Month/ Year

RE: Clinton River and Anchor Bay Watersheds Reconnaissance Study

Dear XXXX:

The U.S. Army Corps of Engineers - Detroit District is undertaking a reconnaissance level study to examine the feasibility of carrying out environmental restoration projects in the Clinton River and Lake St. Clair watersheds, with a focus on the Anchor Bay subwatershed. The study area is located in Macomb and St. Clair counties. (Please see attached map). Conducted under the authority of the federal Water Resources Development Act of 2007, * the study will identify needs, problems, opportunities and recommended actions that might be taken by various partners and stakeholders to address flood protection, ecosystem restoration and recreation objectives in these watersheds.

We are undertaking a thorough, multi-purpose and multi-objective evaluation of the study area to integrate existing plans and studies; assess flood risk management and ecosystem restoration progress to date; and assist public and non-governmental organizations in identifying and planning for future programs and projects in partnership with Federal agencies.

As part of our scoping process, we invite you to identify 1) key ecosystem restoration priorities in the study area, 2) key flood risk management priorities, 3) key water-related recreation opportunities, and 4) specific programs or projects underway or proposed that you believe are important in addressing these priorities. Key issues identified in past study efforts include Combined and Sanitary Sewer Overflows, illicit connections, failing septic systems, nonpoint source pollution, oil and hazardous material spills, habitat restoration, invasive species, water levels, fish passage and spawning habitat, and streambank erosion, among others.

Please direct your comments to (Name) on or before (Date) at the address above, or via email (Address). Questions can be directed to (Name) via email or at (Phone Number). We appreciate your interest and value your input, and will update you as the study proceeds.

Sincerely,

Larry Pawlus
Chief, Programs & Project Management Office

Attachment

**This letter incorrectly cites WRDA 2007 as an authority for this study; WRDA 2007 is the authority for the related adjacent study of the Upper Clinton River watershed. The authorities for the Lower Clinton River and Anchor Bay reconnaissance study is HR 2732 and the River and Harbor Act of 1970, as noted in Section 1.*

Appendix C: Project Identification and Initial Screening

Potential projects in the study area were compiled from input provided by numerous regional entities and stakeholder groups. Project identification was closely aligned with larger watershed and ecosystem restoration planning underway in the study area. In particular, the planning team worked with SEMCOG and the Lake St. Clair/St. Clair River Protection and Restoration Partnership. The Partnership is the coalition of Federal, State, Regional, Municipal agencies and non-governmental organizations responsible for implementing the St. Clair River and Lake St. Clair Comprehensive Management Plan (CMP).

The Partnership's Strategic Implementation Plan (SIP), which sought to identify potential projects to further the objectives of the CMP, was undertaken simultaneously with this Reconnaissance study, and the two processes were closely coordinated. The Partnership organized stakeholder workshops to identify key water resource project of benefit to both plans, and to ensure that well-supported projects were developed and considered for funding support.

The SIP process resulted in stakeholders submitting more than 70 potential projects to address water resource problems in an area that included the study area for this Reconnaissance Study. Working with the Partnership, the study team conducted an initial screening of those projects to determine those with locations within the Clinton River or Anchor Bay watersheds. This initial screening left 59 projects to be reviewed for the USACE development of fact sheets. Those projects were further screened to identify those that appeared to fit under USACE missions for habitat restoration and flood risk management, as well as for detailed location, level of project development, identification of a non-Federal sponsor and other criteria, and were ranked for priority implementation by Partnership members at a final stakeholder workshop. This screening resulted in eight projects being selected for more detailed evaluation in this Reconnaissance Study.

The list of 59 projects identified in the initial screening are located in the following table.

SIP Project #	Project Title	AOC	BUI	GLRI Metric	GLRI Grant and/or Existing Corp Authority	Contructed FY 2012 or beyond	Local Support	Local Sponsor	Feasible?	Ecosystem Restoration	Fact Sheet Ready?	Project > 250,000	Outside Project Area
59	Illicit Discharge Elimination Program (IDEP)	x	x	x	x	x	x	x	x		x	x	
60	Sterling Heights Household Hazardous Waste Outreach	x	x	x	x	x	x	x	x		x	x	
65	Safeguard our Drinking Water Real Time Monitoring	x	x	x	x	x	x	x	x		x	x	
70	Contaminated Source ID and Assessment in Clinton River AOC	x	x	x	x	x	x	x	x		x		
79	Restoring Fish Passage in the Red Run Headwaters	x	x	x	x	x	x	x	x	x	x	x	x
91	North Branch Clinton River Wetland Restoration & Protection	x	x	x	x	x	x	x	x	x	x		
93	Determining & Implementing Stable Channel Design Criteria	x	x	x	x	x	x	x	x	x	x		
94	Sterling Relief Drain Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	
107	Road Salt Impact on Clinton River AOC	x	x	x	x	x	x	x	x		x		
120	Oakland University Stormwater Retrofit Project	x	x	x	x	x	x	x	x	x	x	x	x
126	Galloway Creek Fish Passage Restoration Project	x	x	x	x	x	x	x	x	x	x	x	x
133	Harsen's Island Conservation & Recreation Area		x	x	x	x	x	x	x	x	x	x	
135	HECWFS for Expanding-Decision Support Applications	x	x	x	x	x	x	x	x		x		
137	Addison Dryden Drain Wetland Preservation, Bank Stabilization and Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	
139	Brandon Oxford Drain Wetland Protection and Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	
140	Brown Drain Sediment Removal, Bank Stabilization & Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	
141	Restoration & Improvements to Harsen's Island Conservation Area		x	x	x	x	x	x	x	x	x	x	
143	Hamilton Relief Drain Sediment Removal, Bank Stabilization & Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	x
144	Expanded IDEP Southeast Oakland County Communities	x	x	x	x	x	x	x	x		x	x	x
145	Village of Leonard Sewage Disposal Alternative Evaluation	x	x	x	x	x	x	x	x		x		
146	Clinton River & Lake St. Clair Green Infrastructure Assesment, Design & Implementation	x	x	x	x	x	x	x	x	x	x	x	
147	Low Flow Improvements Study - Clinton River Main Subwatershed	x	x	x	x	x	x	x	x		x	x	x
148	Mainland Drain Project Wetland Creation & Stream Restoration	x	x	x	x	x	x	x	x	x	x	x	x
149	Harsen's Island Blue-Way (waterways) Phragmites Management & Control		x	x	x	x	x	x	x	x	x	x	
154	Otter Drain Sediment Removal, Bank Stabilization & Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	x
157	Roseville Clinton Harrison Relief Drain Water Quality & Habitat Improvement Project	x	x	x	x	x	x	x	x	x	x	x	x
158	Building Collaborations to Manage Phragmites around Lake St. Clair	x	x	x	x	x	x	x	x	x	x		
159	Red Run Drain Sediment Removal	x	x	x	x	x	x	x	x	x	x	x	
160	Clinton River Restoration at Sylvan Lake Outlet	x	x	x	x	x	x	x	x	x	x	x	
161	Red Run Drain Stream Bank Stabilization	x	x	x	x	x	x	x	x	x	x	x	
162	Red Run Drain Contaminated Sediment Removal	x	x	x	x	x	x	x	x	x	x	x	
163	Sinking Bridge Drain Wetland Enhancement	x	x	x	x	x	x	x	x	x	x	x	x
164	Update of Oakland County Design Standards for Storm Water	x	x	x	x	x	x	x	x		x	x	
165	Anchor Bay Watershed Fish & Wildlife Habitat Restoration Plan & Implementation	x	x	x	x	x	x	x	x	x	x	x	
166	Implementing Green Streets in the Lake St. Clair Watershed	x	x	x	x	x	x	x	x	x	x	x	
167	Lake Level Control Structures Flow Monitoring Clinton River	x	x	x	x	x	x	x	x		x	x	
168	Ferry Drain Sediment Removal, Bank Stabilization & Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	x
169	Harrington Drain Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	
177	Partridge Creek Commons Habitat Restoration	x	x	x	x	x	x	x	x	x	x	x	
178	Mount Clemens Ice Rink Stormwater Retrofit/CSO Control	x	x	x	x	x	x	x	x	x	x		
179	Cairns Field Stormwater Retrofit/CSO Control	x	x	x	x	x	x	x	x	x	x		
185	Habitat Restoration through Large Woody Debris Removal-Phase I	x	x	x	x	x	x	x	x	x	x	x	
186	Paint Creek Fish Passage Restoration Project	x	x	x	x	x	x	x	x	x	x	x	x
187	Clinton River Fish Habitat Restoration Project	x	x	x	x	x	x	x	x	x	x	x	x
189	Lake St. Clair Phragmites Management Partnership	x	x	x	x	x	x	x	x	x	x	x	
192	Phragmites Control Through Biofuel Production	x	x	x	x	x	x	x	x	x	x		x
193	Clinton River AOC Watershed Remediation Through Grow Zones	x	x	x	x	x	x	x	x	x	x		
194	Black Creek Marsh Land Acquisition	x	x	x	x	x	x	x	x	x	x	x	x
199	Yates Roadside Park Fish Habitat Restoration & Angler Access	x	x	x	x	x	x	x	x	x	x	x	x
202	Metro Beach Parking Lot Reconstruction Phase 2	x	x	x	x	x	x	x	x	x	x	x	x
210	Metro Beach Marsh Restoration Phase 3	x	x	x	x	x	x	x	x	x	x		x
215	Inwood Road / Stony Creek Storm Water Improvements	x	x	x	x	x	x	x	x	x	x		
217	Stony Creek Floodplain Habitat Restoration / Invasive Species Removal	x	x	x	x	x	x	x	x	x	x		
218	Wolcott Mill Dam Removal & Shoreline Stabilization	x	x	x	x	x	x	x	x	x	x		
219	North Branch Flood Plain Restoration	x	x	x	x	x	x	x	x	x	x		
220	Water Quality Assessment of the North Branch of the Clinton River, Wolcott Mill Metropark	x	x	x	x	x	x	x	x		x		
226	Clinton River Green Corridor Habitat Restoration	x	x	x	x	x	x	x	x	x	x		
229	Off-line Wetland Treatment System for Pelton Creek Drain	x	x	x	x	x	x	x	x	x	x	x	
232	Restoration of the Marine City Drain	x	x	x	x	x	x	x	x	x	x	x	

Appendix D

Source Document Abstracts

ARMY CORPS OF ENGINEERS RECONNAISSANCE STUDY
Clinton River and Anchor Bay Watersheds

Source Document Abstract

Doc Number	01
Title	Clinton River East Subwatershed Management Plan, Executive Summary
Author	Macomb County Planning Department Tetra Tech, Inc. Clinton River East Subwatershed Members
Pub Date	October 2006

General Summary (document purpose, scope, etc.)

Executive Summary describing this WMP developed by the CREW Subwatershed Advisory Group (SWAG) to: 1) fulfill the National Pollutant Discharge Elimination System (NPDES) Phase II requirements (MDEQ's *General Permit No.MIG619000 for Coverage of Storm Water Discharges for Municipal Separate Storm Sewer Systems Subject to Watershed Plan Requirements*) for non-Phase I governmental units in the urbanized area; and 2) make all of the entities represented in the subwatershed eligible for various grant funding opportunities to implement actions for watershed improvement.

The contents of this plan, including the goals and objectives and the actions to meet them, were developed cooperatively by SWAG members with consideration of the input from community leaders, residents, environmental and citizen groups, local businesses, schools, and universities. The content of this document does include areas within the project scope.

Document Relevance to Reconnaissance Study

This executive summary covers the following Phase II permitted communities within the Project Area:
Washington Township, Shelby Township, Macomb Township, Macomb County, Mt. Clemens, Harrison Township, Utica, Fraser, Clinton Township, Sterling Heights.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Entire Document			

Doc Number	02
Title	Clinton River East Subwatershed Management Plan
Author	Macomb County Planning Department Tetra Tech, Inc. Clinton River East Subwatershed Members
Pub Date	October 2006

General Summary (document purpose, scope, etc.)

This WMP developed by the CREW Subwatershed Advisory Group (SWAG) to: 1) fulfill the National Pollutant Discharge Elimination System (NPDES) Phase II requirements (MDEQ's *General Permit No.MIG619000 for Coverage of Storm Water Discharges for Municipal Separate Storm Sewer Systems Subject to Watershed Plan Requirements*) for non-Phase I governmental units in the urbanized area; and 2) make all of the entities represented in the subwatershed eligible for various grant funding opportunities to implement actions for watershed improvement.

The contents of this plan, including the goals and objectives and the actions to meet them, were developed cooperatively by SWAG members with consideration of the input from community leaders, residents, environmental and citizen groups, local businesses, schools, and universities. The content of this document does include areas within the project scope.

Document Relevance to Reconnaissance Study

This WMP covers the following Phase II permitted communities within the Project Area:
Washington Township, Shelby Township, Macomb Township, Macomb County, Mt. Clemens, Harrison Township, Utica, Fraser, Clinton Township, Sterling Heights.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Actions	8.1-8.50	8.1-8.50	Detailed road map for actions.
Funding and Implementation	10.3-10.7	10.3-10.7	Options for funding implementation.

Doc Number	04
Title	Clinton River Watershed Area of Concern Remedial Action Plan Update
Author	Tetra Tech and Clinton River Public Advisory Council
Pub Date	1 Nov 2008

General Summary (document purpose, scope, etc.)

This 1,000-page document summarizes progress made in addressing BUIs in the Clinton River Watershed since the first remedial action plan was developed in 1988. The 2008 update is a Stage II RAP (it includes actions necessary for delisting). It includes highly detailed inventory and analysis of environmental conditions in the watershed; a description and prioritization of stressors to be addressed; an evaluation of potential actions to address BUIs; and a prioritized list of action categories to comprehensively address those impairments.

Document Relevance to Reconnaissance Study

This document is directly applicable to the reconnaissance study. It provides information on existing conditions at a higher level of detail than in required in the 905(b) report, but which can be summarized. It includes specific actions recommended to address delisting of BUIs. It details the key environmental stressors in the watershed. The study area for this document includes both the upper and lower Clinton River Watershed, and the eastern portion of the study are in Macomb and St. Clair Counties is applicable to the present study.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Natural Environment	Ch. 3		Details on environmental inventory of watershed
Environmental Stressors	Ch. 4		Stressors listed and prioritized; can be used to check Watershed Conceptual Model. High Priority: Nutrient, Pathogens, Hydrology, Sediment, Habitat, Organic Compounds, Heavy Metals
Environmental Conditions	Ch. 5		Detailed description of effects of stressors on environment and BUs**. Directly applicable to existing conditions characterization.** Identifies watershed problems and public priorities.
Actions	Ch. 8		Categorized list of actions. Many are not project-specific (i.e. they are policy- or planning-related, or very general). Page 8-14 includes a list of specific demonstration projects. **Details of these potential projects are included in Appendix G3. This is a key source.** Pages 8-39 relates the actions to BUIs.

Doc Number	05
Title	Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes
Author	Great Lake Regional Collaboration of National Significance
Pub Date	December 2005

General Summary (document purpose, scope, etc.)

This (2006) report describes physical and biological characteristics of the Clinton River, discusses how human activities have influenced the river, and intends to serve as an information base for managing the river's future.

The document consists of four parts: an introduction, a river assessment, management options, and public comments and responses. The river assessment is the nucleus of the report. The characteristics of the Clinton River and its watershed are described in twelve sections: geography, history, geology and hydrology, soil and land use patterns, channel morphology, dams and barriers, special jurisdictions, water quality, biological communities, fishery management, recreational use, and citizen involvement. The management options section of the report identifies a variety of challenges and opportunities. These management options are categorized and presented following the organization of the main sections of the river assessment. They are intended to provide a foundation for public discussion, setting priorities, and planning the future of the Clinton River.

Document Relevance to Reconnaissance Study

This report is a comprehensive resource report on the physical, chemical, biological, and societal aspects of the Clinton River Watershed. The report includes numerous contemporary data regarding streamflows, pollutants, biological communities and watershed land use. It is applicable to all sections of the report.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
River Assessment		All	The report is a comprehensive description of physical, chemical, and biological resources and is intended for a general audience.

Doc Number	06
Title	Lake St. Clair Coastal Habitat Assessment and Recommendations for Conservation and Restoration Planning
Author	Great Lakes Commission
Pub Date	2006

General Summary (document purpose, scope, etc.)

Provides a historic and geologic assessment of development in the Lake St. Clair coastal zone; characterizes socio-economic conditions and the US and Canadian planning frameworks; characterization of hydrology and water quality; characterization of ecosystems, plant and animal communities; system stressors and programs designed to respond to those stressors; GIS tools for ecosystem analysis; and recommendations for coastal habitat management and restoration.

Document Relevance to Reconnaissance Study

Provides data for existing conditions analysis. The recommendations are broader and more process oriented than those in a typical 905(b) study; however, the recommendations may be used to create screening and prioritization criteria for potential projects.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Physical and ecosystem	III-IV	49-108	Details on physical and habitat conditions in coastal zone
Recommendations	VIII	215-231	Recommendations are at high level (ie.not project specific), may be used as a prioritization tool

Doc Number	07
Title	Criteria for Restoration of Beneficial Use Impairments to the Clinton River Area of Concern
Author	Clinton River AOC Public Advisory Council
Pub Date	9 April 2009

General Summary (document purpose, scope, etc.)

Detailed delisting criteria for eight Beneficial Use Impairments in the Clinton River AOC. The BUIs are: Restrictions on Fish and Wildlife Consumption; Degradation of Benthos; Restrictions on Dredging Activities; Eutrophication; Beach Closings; Degradation of Aesthetics; Degradation of Fish and Wildlife Populations; Loss of Fish and Wildlife Habitat

Document Relevance to Reconnaissance Study

The delisting criteria may be used as a screening factor for potential projects to be evaluated in the reconnaissance study.

The degree to which potential projects address the BUI delisting criteria may be used as a prioritization factor in the strategic plan component of the project.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	08
Title	Delisting Target for Non-habitat Beneficial Use Impairments for the Clinton River Area of Concern
Author	Clinton River Watershed Council and ECT, Inc
Pub Date	30 April 2009

General Summary (document purpose, scope, etc.)

Detailed delisting criteria for five non-habitat related Beneficial Use Impairments in the Clinton River AOC. The BUIs are: Restrictions on Fish and Wildlife Consumption; Restrictions on Dredging Activities; Beach Closings; Degradation of Aesthetics; Eutrophication. This document mirrors Document 7 (which also includes habitat related BUI delisting targets.

Document Relevance to Reconnaissance Study

The delisting criteria may be used as a screening factor for potential projects to be evaluated in the reconnaissance study.

The degree to which potential projects address the BUI delisting criteria may be used as a prioritization factor in the strategic plan component of the project.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	09
Title	Clinton River AOC: Wetland Status and Trends
Author	Department of Environmental Quality: Land and Water Management Division
Pub Date	

General Summary (document purpose, scope, etc.)

This document identifies the changes in wetlands between the time of presettlement and 1978. Maps of the area of concern within the counties of Oakland, Macomb, Lapeer, and St. Claire display areas of wetlands at presettlement, in 1978, and the areas of wetland loss by 1978. Additional maps identify areas of potential wetland restoration near water bodies in the Clinton River Watershed. The areas identified are within the following water body areas: North Branch and Clinton River East, Paint and Stony Creek, Red Run and St. Claire, and Upper and Main Clinton.

Document Relevance to Reconnaissance Study

This document is not completely relevant to the reconnaissance study, as it does not identify existing conditions or specific projects of interest. This document does identify areas for wetland restoration, which can be used for the justification or selection of specific projects that are identified in other reports.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	10
Title	Delisting Targets for Fish and Wildlife BUI for Clinton River AOC
Author	Environmental Consulting & Technology, Inc.
Pub Date	May 2009

General Summary (document purpose, scope, etc.)

This (2009) report discusses the Clinton River Watershed delisting targets project, which developed endpoints that would allow for ultimate delisting of the watershed as an Area of Concern under the Great Lakes Water Quality Agreement.

This report is separated into seven sections, which include an executive summary, project introduction and rationale, historical habitat and population issues in the AOC: impairment by water quality, delisting targets for fish/wildlife habitat/population beneficial use impairments, selecting demonstration sites for habitat BUIs restoration, final delisting targets for selected restoration sites, and conclusions and recommendations.

Document Relevance to Reconnaissance Study

This report identifies existing conditions in the Clinton River watershed, as it discusses trends in water quality and quantity, the biological community in the river, and trends in sediment contamination. Potential projects for meeting delisting targets for fish/wildlife habitat/population beneficial use impairments in the watershed are also discussed.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Historical Habitat and Population Issues	3.0	8-23	A description of water quality and quantity trends, the biological community in the Clinton River, trends in sediment contamination, and natural resource values and important AOC features.
Delisting Targets for Beneficial Use Impairments	4.0	24-26	Restoration targets and actions for the loss of fish and wildlife habitat and the degraded fish and wildlife populations in the Clinton River.
Selecting Demonstration Sites for BUIs	5.0	27-31	Key parameters and project types for adopting at specific sites. Also, an identification of broad restoration categories to delist the AOC and specific sites for these categories.
Final Delisting Targets for Selected Sites	6.0	32-58	A list and description of identified restoration projects within the Clinton River watershed for meeting delisting targets in the Areas of Concern.

Doc Number	11
Title	Special Report 39 – Clinton River Assessment
Author	James T. Francis and Robert C. Haas
Pub Date	June 2006

General Summary (document purpose, scope, etc.)

This (2006) report describes physical and biological characteristics of the Clinton River, discusses how human activities have influenced the river, and intends to serve as an information base for managing the river's future.

The document consists of four parts: an introduction, a river assessment, management options, and public comments and responses. The river assessment is the nucleus of the report. The characteristics of the Clinton River and its watershed are described in twelve sections: geography, history, geology and hydrology, soil and land use patterns, channel morphology, dams and barriers, special jurisdictions, water quality, biological communities, fishery management, recreational use, and citizen involvement. The management options section of the report identifies a variety of challenges and opportunities. These management options are categorized and presented following the organization of the main sections of the river assessment. They are intended to provide a foundation for public discussion, setting priorities, and planning the future of the Clinton River.

Document Relevance to Reconnaissance Study

This report is a comprehensive resource report on the physical, chemical, biological, and societal aspects of the Clinton River Watershed. The report includes numerous contemporary data regarding streamflows, pollutants, biological communities and watershed land use. It is applicable to all sections of the report.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
River Assessment		All	The report is a comprehensive description of physical, chemical, and biological resources and is intended for a general audience.

Doc Number	12
Title	Great Lakes Restoration Initiative Action Plan FY2010 – FY2014
Author	White House Council on Environmental Quality
Pub Date	February 2010

General Summary (document purpose, scope, etc.)

This (2010) report identifies goals, objective, measurable ecological targets, and specific actions for each of the five focus areas identified. The Action Plan will be used by federal agencies in the development of the federal budget for Great Lakes restoration in fiscal years 2011 and beyond.

The document consists of the following sections: The action plan, implementing the action plan, and five focus areas. These focus areas consist of toxic substances and areas of concern, invasive species, near-shore health and non-point source pollution, habitat and wildlife protection and restoration, and accountability, education, monitoring, evaluation, communication, and partnerships.

Document Relevance to Reconnaissance Study

This Action Plan outlines methods and actions to advance implementation of the Great Lakes Restoration Initiative through FY 2014 and will help protect and restore the chemical, physical, and biological integrity of the Great Lakes Basin ecosystem. The criteria and principles for selecting programs and projects pursuant to the Action Plan are also identified in this report. Five principal focus areas are identified to encompass the most significant environmental problems in the Great Lakes (other than water infrastructure) for which urgent action is required.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Project Selection	Project Selection	14-15	This section identifies the criteria, principles, and standards for which programs and projects, pursuant to the Action Plan, are selected.
Focus Area 1: Toxic Substances	Focus Area 1	17-21	Discusses long term goals, objectives, and actions to achieve progress for the remediation of toxic substances in areas of concern within the Great Lakes.
Focus Area 2: Invasive Species	Focus Area 2	22-26	Discusses long term goals, objectives, and actions to achieve progress for the prevention of invasive species into the Great Lakes.
Focus Area 3: Near-shore Health	Focus Area 3	26-30	Discusses long term goals, objectives, and actions to achieve progress for improving the health of nearshore areas and reducing nonpoint source pollution.
Focus Area 4: Habitat and Wildlife Protection	Focus Area 4	31-35	Discusses long term goals, objectives, and actions to achieve progress for Great Lakes habitat and wildlife protection.
Focus Area 5: Account, Educate, Monitor, Eval., Comm., Partner	Focus Area 5	35-39	Discusses long term goals, objectives, and actions to achieve progress for the improvement of collaborative Great Lakes decision making, transparency, and accountability for Great Lakes information.

Doc Number	13
Title	Lakewide Management Plan Updates for the Great Lakes
Author	Great Lakes Commission
Pub Date	2008

General Summary (document purpose, scope, etc.)

Lakewide Management Plans are action plans that assess, restore, protect, and monitor the health of the five Great Lakes. The Plans are an example of the ecosystem approach to adaptive management that integrates environmental, economic, and social consideration along ecological boundaries.

The document, for each Great Lake and also Lake St. Claire, gives an overview, goals and progress, and next steps for improving the aquatic health.

Document Relevance to Reconnaissance Study

This report is a comprehensive resource report on the physical, chemical, biological, and societal aspects of the Clinton River Watershed. The report includes numerous contemporary data regarding streamflows, pollutants, biological communities and watershed land use. It is applicable to all sections of the report.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Lake St. Claire Overview		7	A brief overview of the location, history, and ongoing management of Lake St. Claire.
Lake St. Claire Goals and Progress		7-8	A discussion of recommendations for restoration measures. The plan includes 110 recommendations that have been prioritized into six key areas.
Lake St. Claire Next Steps		8	Discusses the short term goals for the U.S. Lake St. Claire watershed to find local funding for two projects – a real-time monitoring system and control of Phragmites.

Doc Number	14
Title	Michigan LID Manual
Author	SEMCOG
Pub Date	2008

General Summary (document purpose, scope, etc.)

This is a guidance document on low impact development techniques used for storm water management.

Document Relevance to Reconnaissance Study

Not site specific for engineered design utilizing LID concepts, however, provides relevant site data required if LID concepts are used in a recommended restoration project for the recon report.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 3		15-31	Key determinates in using LID concepts in Michigan
Chapter 6		57-121	Non-Structural LID BMPs
Chapter 7		121-334	Structural LID BMPs

Doc Number	15
Title	Michigan Great Lakes Plan
Author	Office of the Great Lakes Michigan Department of Environmental Quality
Pub Date	January 2009

General Summary (document purpose, scope, etc.)

The MI-Great Lakes Plan complements the GLRC by providing specific direction within Michigan. It addresses the recommendations of the GLRC, and highlights the specific needs, challenges, and strengths of our state. The fundamental premise of the MI-Great Lakes Plan is that the economy and the long-term wellbeing of our citizens are dependent on the health of the waters that feed the lakes and the nearshore areas that buffer the lakes.

The plan identifies the following recommendations:

- Ensure that alternative energy sources are pursued and that the environmental impacts of current energy sources are minimized.
- Restore and delist Michigan's 14 Areas of Concern.
- Protect human health associated with fish consumption advisories and harmful algal blooms.
- Restore beaches by controlling pollutants such as phosphorus, pharmaceuticals, and bacterial contamination.
- Prevent the introduction and control the spread and of new invasive species.
- Update old and deteriorating infrastructure throughout the state.
- Ensure effective and efficient management of urban stormwater.
- Implement and share effective land use planning tools throughout the state and across county boundaries.
- Increase opportunities for the public to access the Great Lakes and our inland lakes and streams.
- Protect and restore critical fish and wildlife habitat.

Document Relevance to Reconnaissance Study

This document focuses on the goals outlined in the Great Lake Collaboration Strategy and discusses how these goals apply to Michigan. In addition to the recommendations given, there is some narrative that outlines the potential for the creation of jobs. This can be useful for supplementing the Labor Force, Employment, and Income section. In addition, there is a brief write up about the issues within the Clinton River Watershed that stresses a public stewardship.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Clinton River Area Watershed Issues		16	Brief narrative that discusses the challenges faced within the watershed.
SE Michigan Issues		17-18	SE Michigan Area Issues
AOCediments		43-48	Backgrounds, Success Stories, Funding Options

Doc Number	16
Title	SEMCOG Regional Water Quality Survey Findings Report
Author	ETC Institute
Pub Date	September 2004

General Summary (document purpose, scope, etc.)

This document provides a survey to provide a benchmark to gauge the effectiveness of regional and local public outreach campaigns, leverage resources, and provide the opportunity to compare results from different areas of the SEMCOG region. Overall, survey shows residents are concerned about quality of rivers and lakes in SE Michigan. Most importantly, there is a willingness to make adjustments in daily household habits to protect water resources.

Document Relevance to Reconnaissance Study

This document provides general baseline data in gauging positive feedback from residents in the project study area relevant to our reconnaissance study. The demographic data is not very relevant because it is not specified for our subject subwatersheds. However, the survey questions are classified by subwatershed which can be reviewed for relevance to our recon report regarding non-point sources.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Crosstabs by Watershed	3	Tabs 1-49	Review survey response for watershed codes 2,3,4,5,6,7,13 and 14

Doc Number	17
Title	Clinton River Watershed / Area of Concern (AOC) Clinton River Restoration Plan
Author	Tetra Tech, Inc.
Pub Date	2008

General Summary (document purpose, scope, etc.)

The Clinton River Restoration Plan is a comprehensive Remedial Action Plan (RAP) document that updates the actions to address the beneficial use impairments (BUIs), with the primary purpose being to achieve delisting of the watershed as an AOC through restoration of the eight beneficial uses that have been classified as impaired.

Document Relevance to Reconnaissance Study

This most recent version document of RAP is relevant to the reconnaissance study by strategically integrating specific local planning documents (ie. subwatershed plans) with the long term goal of delisting BUIs. The study can be useful in targeting the project study area for the recon report with specific actions.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 2	2-3,2-4	40,41	Jurisdictional and subwatershed listings specific to recon report study area
Chapter 3	3-38 through 3-50	86-101	Subwatershed characteristics for Clinton River East, Lake St Clair Direct Drainage, North Branch, Red Run, Stony Creek subwatersheds
Ch. 8, Fig. 8-1	8-1	308	Urbanized areas in project area mandated by NPDES permit to implement Phase I/Phase II actions.
Ch. 8, Fig. 8-2	8-2	310	General timeline milestones for comprehensive list of action items
Ch. 8	8-39 through 8-72	345-379	BUIs of medium to high concern for Clinton River East, Lake St Clair Direct Drainage, North Branch, Red Run, Stony Creek subwatersheds
Ch. 8	8-73 through 8-76	379-382	Prioritization of actions based on achieving 4 or more objectives for a BUI and modeling recommendation/phase II NPDES permit support

Doc Number	18
Title	Strategy for Delisting Michigan AOCs
Author	MDEQ
Pub Date	January 4, 2010

General Summary (document purpose, scope, etc.)

Stakeholders in the AOC program can use this document to set local priorities for actions and support local projects to complete needed actions. Actions identified to achieve BUI restoration criteria are not regulatory actions. The AOC Action Tracking Table outlines status of each BUI, criteria, support needed, status of assessment, the actions needed, and projected timeframe. Actions needed are described as belonging to planning/design, remedial action, monitoring, and documentation/assessment.

Document Relevance to Reconnaissance Study

The document provides an Action Table that can be searched for relevant projects in our specific project area in the Clinton River subwatersheds of Clinton River East, North Branch, Red Run, Lake St Clair Direct Drainage, Stony Creek and Anchor Bay. The three tier approach allows for easy identification of the timeframe estimated for each action item.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Appendix A		All	Recon Report can determine relevant AOC strategies based on columns “Area of Concern Name” and “Actions Needed”

Doc Number	19
Title	Michigan Department of Environmental Quality Water Bureau Measures of Success
Author	Michigan Department of Environmental Quality
Pub Date	November 2009

General Summary (document purpose, scope, etc.)

The Water Bureau's mission is to make Michigan's waters safe and clean for drinking, recreating, fishing, and healthy aquatic ecosystems. To provide definition to this mission, the bureau has identified five major goals:

- Ensure Safe Drinking Water;
- Protect Groundwater;
- Enhance Recreational Waters;
- Ensure Consumable Fish; and
- Protect and Restore Aquatic Ecosystems.

For each major goal, measurable outcomes (measures of success) are identified. These measures are primarily based on what we can presently measure. Measurements provide insights in many areas, including informed priority setting and daily decisions; finding problems and assessing their relative importance; identifying preventable causal factors; and communicating progress and problems. Measurement reinforces the importance of a goal and managerial priorities, and helps us gauge how well prior actions worked and when adjustments are needed.

These goals and measurements are intended to enlist external assistance, encourage cooperation across organizational boundaries, and encourage discussion about strategic adjustments and priority trade-offs. T

This document is intended to report on the progress of these goals.

Document Relevance to Reconnaissance Study

This document is a progress report on the achievement of the goals stated from the Water Bureau's mission statement. A majority of the report is outside of the study area, but some of the report provides narrative Michigan's AOCs. A small portion of the information in this report can be used to support some of the heath and fisheries sections but is only broadly relevant.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
		All	Progress report of the goal achievement

Doc Number	20
Title	Stony/ Paint Creek Subwatershed Management Plan
Author	Clinton River Watershed Council Environmental Consulting & Technology, Inc. Carlisle/Wortman Associates, Inc. Applied Science, Inc.
Pub Date	November 2005

General Summary (document purpose, scope, etc.)

The combined Stony/Paint Subwatershed Plan was developed as partial fulfillment of the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) Phase II stormwater regulations. The purpose of the Plan is two-fold:
(1)To identify current sources and causes of impairment in order to determine actions necessary to restore the streams to stable conditions, and
(2)To recommend actions that will prevent further degradation of Stony and Paint Creeks and their watershed resources as development advances on the landscape.

A recurring theme in this Plan is the importance of maintaining the rural character and natural "viewsheds" that makes these subwatersheds such attractive places to live. Protection of the subwatershed's water resources and natural features is a critical component in maintaining the high quality of life enjoyed by Stony and Paint Creek residents.

A comprehensive assessment of Stony Creek was completed in mid 2003 to assess the overall conditions of the stream and riparian corridor. A similar comprehensive assessment of Paint Creek was completed in 2004 and 2005.

Current overall conditions for both subwatersheds are summarized by the following impairments; Hydrologic alterations, sediments, nutrient loading (phosphorus), bacteria, elevated temperatures, organic compounds/heavy metals, and salt.

Document Relevance to Reconnaissance Study

The Stony Creek/Paint Creek Subwatershed Management Plan focuses on watershed based planning initiatives similar to the framework of study for the reconnaissance report. Relevance to watershed planning in the Clinton River began in 1972 when the United States and Canada signed the Great Lakes Water Quality Agreement which identified Areas of Concern (AOC) in the Great Lakes basin. The Clinton River Remedial Action Plan (RAP), first developed in 1988 to define strategies for restoring and protecting the river had initially designated AOC along the main branch of the Clinton River and spillway downriver of Red Run. However, in the early 1990s, processes involving the RAP designated the entire Clinton River watershed as an Area of Concern. Encompassing the entire Clinton River watershed designation was led by the intent to provide a more holistic, watershed approach to manage water quality concerns and to more adequately address the impacts from sources upstream from the initial designated AOC. This Plan works in close coordination with the processes involving the RAP studies. The RAP publication will be reviewed in addition to this Plan for an understanding of the comprehensive planning actions respective to the reconnaissance report. The most recent RAP update prior to this Plan identifies the primary pollutants of concern as storm water runoff and its associated pollutants, contaminated sediments, and bacterial contamination, largely from sewer overflows and failing on-site sewage disposal systems. This document provides management plans for Stony Creek and Paint Creek subwatersheds. In taking a watershed approach, the subwatersheds will need to continue monitoring for detrimental environmental impacts based upon data trends projecting continued development of the communities. In addition, watershed planning needs to take into account the various land management agencies exist in the two subwatersheds. Four categories of management recommendations were developed, from which each could choose from an array of best management practices for water resource and natural features protection:

1) Plans and Policies
2) Development/Redevelopment Regulations
3) Design Standards and Maintenance Practices
4) Education and Stewardship

With this report's focus on creek preservation efforts in minimizing impacts to both subwatersheds, key management plan elements related to the reconnaissance study can be derived for the specific project area at hand.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 3. Existing Conditions	3.1-3.45	All	Categorized by community which can be directly pulled out for respective communities for Recon Report.
Chapter 4. Analysis of Community Plans	4.2-4.2.13	All	Provide summary of Community Plans for those relevant to the Recon Report.
Chapter 5	All	All	Provides goals and objectives and specific actions for implementation within the relevant communities to the Recon Report.

Doc Number	21
Title	Anchor Bay Watershed Management Plan
Author	Anchor Bay Technical Committee, FTC&H
Pub Date	April 2006

General Summary (document purpose, scope, etc.)

Document summarizes existing conditions, public participation and education strategy, watershed goals and objectives, proposed actions and BMPs, subwatershed and community action plans, and methods of measuring progress. Overall goal of the watershed plan is to reduce impacts of pollutants to reduce/eliminate impairments and protect water quality and natural habitat through community and county level implementation of BMPs.

Document Relevance to Reconnaissance Study

Document is a watershed-wide framework for addressing water quality in Anchor Bay. Some hydrologic and hydraulic elements are included, and sedimentation concerns are discussed.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Summary of watershed	1.02	1	Anchor Bay watershed is 171 square miles, and includes 473 miles of waterways.
Estimated sediment loading	1.1.4.2	21	Estimated sediment loading from agricultural areas is 13,637 tons per year, and 7.723 tons per year from urban areas. See Appendices 1E and 1F.
Flow Rate Monitoring and Studies	1.1.4.4	26-27	Flow monitoring was conducted at three sites in 2004 to calibrate the hydrologic model. Preliminary conclusions indicated that bankfull flows may be lower than those used by the MDEQ model.
Actions and BMPs	4	Table 4.1 59	Numerous BMPs listed to address sediment and hydrologic flow. Maintenance, environmental, hydrologic, cost, and other concerns listed.
Subwatershed and Community Action Plans	5	89-100	Summarizes community imperviousness and stormwater ordinance recommendations based on hydrologic analysis.
Methods of Measuring Progress	6	118, 121	Framework for evaluating progress and coordination of local counties, municipalities, and organization along with MDEQ, and MDNR. NRCS, NPDES Phase II, and St. Clair County Soil Erosion and Sedimentation Control (SESC) programs are integral in setting criteria for progress.

Doc Number	22
Title	Anchor Bay Watershed Management Plan – Volume II- Appendices
Author	Anchor Bay Technical Committee, FTC&H
Pub Date	December 1, 2003

General Summary (document purpose, scope, etc.)

Document supplements WMP with support data, public involvement surveys, and references.

Document Relevance to Reconnaissance Study

The data provided in these appendices may be useful in developing existing conditions.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
State of Watershed Support Data	A	3-13	Provides map of monitoring sites (including near and offshore), failing septic systems, and locations exceeding level of concern DO. Tables include list of permitted dischargers, water quality parameters and years samples, and water quality analysis results.
Inventory of Typical Tributary Drains	B	14-24	Inventory and notes from 2002 inventory of St. Clair County watershed drains.
Crapau Creek TMDL	C	25-41	MDEQ TMDL for *Escherichia coli* along two miles of Crapau Creek, which is listed as a BUI area for recreation.
Macomb County's Onsite Sewage Disposal and Water Supply Ordinance	G	165-183	Regulations governing on-site sewage disposal and on-site water supply systems.
References	I	189-196	List of additional references for Anchor Bay.

Doc Number	23
Title	Anchor Bay Watershed Transition/Implementation Project: Technical report for Watershed Management Plan
Author	FTC&H
Pub Date	April 2006

General Summary (document purpose, scope, etc.)

Document supplements Anchor Bay Watershed Management Plan and describes stream hydrology, hydraulics, and morphology analysis, evaluation, conclusions, and recommendations to maintain a stable system of streams.

Document Relevance to Reconnaissance Study

Document provides regional curve development through the analysis of 16 reference reaches. Profiles, cross sections, and bankfull discharge are presented. A HEC-HMS model was developed, and analysis was provided for a variety of buildout scenarios and future land cover capacities. Data is included as an appendix.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Reference Reaches	1	3-11	Includes profiles, cross sections, pebble counts, stream classification, and regional curves.
Rainfall and Stream Monitoring	2	12-15	Difference between effective discharge and bankfull discharges are likely due to historic channel dredging.
Hydrologic Analysis	3	16-29	Analysis was conducted to determine the most effective detention policies to protect streams in the watershed from development-induced streambank erosion. The Salt River was selected for modeling with HEC-HMS with average sub-catchment area of 29 acres, for pre and post development.

Doc Number	24
Title	Anchor Bay Watershed Management Plan Technical Report Appendices
Author	Anchor Bay Technical Committee, FTC&H
Pub Date	April 2006

General Summary (document purpose, scope, etc.)

Document supplements technical report with survey and existing conditions data.

Document Relevance to Reconnaissance Study

The data provided in these appendices will be useful for modeling and river restoration planning. Note that table of contents does not necessarily correspond with appendix elements.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Regional Curve Data	1	1-3	Provides regional curves comparing bankfull area, bankfull width, and bankfull depth to drainage area.
Reference Reach Cross Sections	2	4-35	Surveyed cross sections and longitudinal profiles for reference reaches.
Reference Reach Longitudinal Survey	3	36-49	Bankfull areas and discharge for reference reach cross sections.
Bed Material Analysis	4	50-62	Discharge (CFS) and frequency analysis for reference reaches.
Rosgen Stream Classification	5	63-75	Pebble counts, bed material particle size distributions,
MDEQ Discharge data	6	76-90	Rosgen Level II Stream classifications for reference reaches.
Rainfall Data	7	91-94	Cumulative rainfall depth, stream stage, and hyetograph over two month and 5 day events at three locations.
Stream Flow Monitoring	8	95-107	Discharge vs. depth curves, velocities, etc for three locations.
Maryland Method for Computing Channel Protection Storage Volume	9	108-112	Sample method for designing channel protection storage volume.
Development of CN Method	10	113-123	Explanation and data for CN developed by FTC&H
Draft Model Stormwater Ordinance	13	133-167	Draft ordinance; purpose has many overlaps with BUIs for this study.

Doc Number	25
Title	Anchor Bay Watershed Management Plan – Fact Sheet
Author	Anchor Bay Technical Committee
Pub Date	August 9, 2004

General Summary (document purpose, scope, etc.)

Document is a concise summary of the Anchor Bay Watershed Management Plan including goals, activities and partners.

Document Relevance to Reconnaissance Study

Decribes project activity from October 2001 to December 2003, including long term goals of restoring and enhancing recreational uses, restoring and protecting aquatic life and wildlife's habitat, protecting public health, and reducing impacts from peak flows.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	26
Title	Illicit Connection Elimination Project, Anchor Bay and Pine River Watersheds
Author	St. Clair County Drain Commissioner's Office
Pub Date	14 Feb 2005

General Summary (document purpose, scope, etc.)

This fact sheet reports on progress of the St. Clair County Drain Commissioner's project to identify and eliminate illicit sanitary cross connections to the stormwater drainage system in the Anchor Bay and Pine River watersheds in St. Clair County. The fact sheet reports on activities from January 2002 to December 2004: 89 illicit connections identified through systematic survey of county drains. Failing septic systems accounted for 86 of the illicit connections; owners have corrected 48 connection at the time of writing, removing 2.2 million gallons of wastewater from surface waters annually. As other connections are addressed, the project is estimated to remove an additional 4.1 million gallons yearly.

Document Relevance to Reconnaissance Study

Documents water quality problem in Anchor Bay watershed, and suggests future steps to continue to eliminate illicit connections.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Annual load reductions		1	Estimates load reductions achieved through the project

Doc Number	26
Title	St. Clair County Illicit Connection Elimination Fact Sheet
Author	Michigan Department of Environmental Quality and St. Clair County Drain Commission
Pub Date	February 2005

General Summary (document purpose, scope, etc.)

This fact sheet briefly describes the goals, best management practices, annual load reductions, and future activities of the St. Clair County Drain Commission's Illicit Connection Elimination Project. Pictures displaying obvious signs of contamination are also presented. Illicit connections are a preventable source of non-point source pollution of nutrients into Anchor Bay and Pine River Watersheds.

Document Relevance to Reconnaissance Study

This fact sheet is not relevant to the reconnaissance study, as it does not identify existing conditions or specific projects to be implemented.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	27
Title	St. Clair County Illicit Connection Elimination Fact Sheet
Author	Michigan Department of Environmental Quality and St. Clair County Health Department
Pub Date	April 2005

General Summary (document purpose, scope, etc.)

This fact sheet briefly describes the goals, activities, results, and future activities of the St. Clair County Health Department Illicit Connection Elimination Project. Illicit connections are a preventable source of non-point source pollution of nutrients into Anchor Bay and Pine River Watersheds.

Document Relevance to Reconnaissance Study

This fact sheet is not relevant to the reconnaissance study, as it does not identify existing conditions or specific projects to be implemented.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	27
Title	Illicit Connection Elimination Project, St. Clair River Watershed
Author	St. Clair County Health Department
Pub Date	8 Apr 2005

General Summary (document purpose, scope, etc.)

This fact sheet reports on progress of the St. Clair County Health Department's project to identify and eliminate illicit sanitary cross connections surface water in the St. Clair River Watershed in St. Clair County. The fact sheet reports on activities from March 2002 to September 2004: More than 1,000 miles of streams, shoreline and road ditches were surveyed and sampled for E. Coli and detergent presences. 3,615 outfalls were located in 17 communities. Identified 297 illicit connections of sanitary systems to surface water; 295 of these were failing septic systems. Forty-nine percent of connections corrected at time of writing. When all are corrected, will remove 14.1 million gallons annually from surface water; identified areas with clusters of illicit connections that may require regional solutions.

Document Relevance to Reconnaissance Study

Documents water quality problem in St. Clair County watersheds, and suggests future steps to continue to eliminate illicit connections.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	28
Title	Macomb County Office of Public Works Illicit Discharge Elimination Fact Sheet
Author	Michigan Department of Environmental Quality and Macomb County Public Works Office
Pub Date	July 2005

General Summary (document purpose, scope, etc.)

This fact sheet briefly describes the goals and accomplishments of the Macomb County Office of Public Works Illicit Connection Elimination Project. Illicit connections are a preventable source of non-point source pollution of nutrients into the Anchor Bay Watershed, Lake St. Clair drainage area, and the Bear Creek Watershed.

Document Relevance to Reconnaissance Study

This fact sheet is not relevant to the reconnaissance study, as it does not identify existing conditions or specific projects to be implemented.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	29
Title	Macomb County Health Department Illicit Discharge Elimination Fact Sheet
Author	Michigan Department of Environmental Quality and Macomb County Health Department
Pub Date	January 2006

General Summary (document purpose, scope, etc.)

This fact sheet briefly describes the goals and accomplishments of the Macomb County Health Department's Illicit Discharge Elimination Project. Illicit connections are a preventable source of non-point source pollution of nutrients into the Clinton River Watershed, the Anchor Bay Watershed, Lake St. Clair Watershed, and the Bear Creek Watershed.

Document Relevance to Reconnaissance Study

This fact sheet is not relevant to the reconnaissance study, as it does not identify existing conditions or specific projects to be implemented.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	30
Title	Harrison Township Failing On-Site Disposal System Correction Fact Sheet
Author	Michigan Department of Environmental Quality and Harrison Township
Pub Date	August 2005

General Summary (document purpose, scope, etc.)

This fact sheet briefly describes the goals, best management practices, annual load reductions and accomplishments of the Harrison Township Failing On-Site Septic System Correction Project. Septic systems in this area are not suitable and therefore cause non-point source contamination of nutrients to the Clinton River and Lake St. Clair.

Document Relevance to Reconnaissance Study

This fact sheet is not relevant to the reconnaissance study, as it does not identify existing conditions or specific projects to be implemented.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	33
Title	Hydrologic and Geomorphic Analysis of the Clinton River Watershed: Final Report
Author	ECT, Inc.
Pub Date	March 31, 2006

General Summary (document purpose, scope, etc.)

This project was funded under Section 319 of the Clean Water Act by the U.S. Environmental Protection Agency to the Michigan Department of Environmental Quality. The grant recipient was Macomb County Public Works Office. The study consists of detailed hydrologic and geomorphic assessments of the Clinton River Watershed. The hydrologic study comprised of careful analysis of over forty years of data from sixteen U.S. Geological Survey gages within the watershed. The geomorphic study comprised of historical stream location analysis, data collection from a forty square mile subwatershed, and detailed analysis of data. Using Bank Erosion Hazard Index (BEHI), Rosgen techniques, and Pfankuch method, conclusions are drawn classifying the stability of the river and recommendations for site-specific Best Management Practices (BMPs) are then made. A protocol is then developed to identify the existing condition of any Southeast Michigan watershed as well as to select what specific BMPs may be implemented with a focus on sustained long-term success.

This project is a detailed study to develop an accurate picture of the geomorphic and hydrologic variability in the Clinton River and how that variability has been impacted by changes in landuse within the watershed. Additionally, this effort is designed to provide the information that could serve as a key input for future water quality studies (such as TMDL studies, nutrient management and/or in studies that provide advanced predictor models for beach closings) within the Clinton River watershed. Another key outcome of the work is the quantification of hydrologic/hydraulic driving forces that can help evaluate any future design and implementation of best management practices (BMPs) with more certainty than currently possible. These BMPs could be related to channel restoration, stabilizing stream banks, improving livestock pasture management, and improving road crossings (culverts and single span bridges) in the headwaters of the Clinton River Watershed. Specifically, results from this study will also directly help complete the BMP engineering design and implementation for five stream bank erosion sites that were identified and prioritized in the Middle Branch of the Clinton River Road Crossing and Streambank Inventory Report (August 14, 2000) by Environmental Consulting & Technology, Inc

Conclusions made as a result of this study are as follows:
A large portion of the Clinton River Watershed is currently not in a state of equilibrium from both a hydrologic and geomorphic standpoint. This is particularly evident in the Middle Branch of the Clinton River Watershed where a pilot study site to characterize the stream condition in this urbanizing watershed. With the understanding of the river morphology, and the set of predictive protocols that have been developed as a result of this project, landuse managers and engineers can apply successful Best Management Practices to address an extensive variety of hydrologic and geomorphic problems related to past and future development pressures within the region. These tools include:

- Analyzing various hydrologic parameters to determine numerous flow trends in the watershed. This highlights regions where flow variability is greatest within a watershed which can then be addressed by local ordinances.
- Characterizing the existing state of a watershed using land use analysis and development trends. These trends can then be compared with development trends to initially determine a link between flow variability and local development practices.
- River classification and erosion analyses to assess the watershed's streams and determine the existing departure from equilibrium. These analyses assist in determining the stream's erosion potential, natural recovery potential, and numerous other parameters that may assist in determining the content and success of a restoration strategy.
- Developing regional curves to characterize and quantify if the stream is currently in an eroded or aggraded state
- The use of a drain/stream design template for future developments or stream modification projects based on regional curve information
- Determination of the current state of a river system in a channel evolutionary model in order to prioritize restoration and quantify the success rate of applied Best Management Practices.

Document Relevance to Reconnaissance Study

This document provides background of the Clinton River, historical and statistical trends of the river's hydrology, land management and use for the watershed, geomorphic study on study reach and associated assessment of future development and protection measures, and watershed wide ordinance recommendations. Although the study stream is not within the Reconnaissance Study area, the information obtained that can be applied to the watershed as a whole is relevant to the Reconnaissance Study.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Background of the Clinton River	All	All	Provides background information of the Clinton River.
Statistical Trend Analysis of Flows	All	All	Provides information relating to the hydrologic trends over several decades for the river.
Land Management Measures	All	All	Provides information on the link between the hydrological trends and the land management and use trends.
Assessment of Future Development Impact and Formulation of Related Protection Measures	All	All	Provides information regarding land use and its impact on the stability of the stream.
Conclusions	All	All	Provides study conclusions and watershed wide recommendations.

Doc Number	34
Title	Freshwater Mussels In The Clinton River, Southeastern Michigan: An Assessment Of Community Status
Author	Debbie Morowski, Luke J. James, and R. Douglas Hunter, *Oakland University*
Pub Date	December 3, 2009

General Summary (document purpose, scope, etc.)

This study compared data from a survey of freshwater mussels at seventy-six sites in summer 2004 in the Clinton River and compared the results to historical data from the 1980 survey.

The report concludes that species richness declined from 30 species from 1935 to 24 in 1978 and decreased again to 14 in 2004. Overall mussel density also declined from during these periods. These declines occurred in all seven subregions of the watershed except for the lower mainstem where no mussels were found.

Outside of the appearance of two species of exotic bivalves since the 1978 study, only the invasive zebra mussel is likely to have had an impact. Like many semi-urban watersheds, the Clinton River has suffered from increases in impervious surface which has led to increased storm water runoff, geomorphologic instability, and increased non-point source contaminant concentrations. Regulation of lake level control structures in drought months has also contributed to hydrodynamic instability.

Freshwater mussels of the Clinton River face two significant threats which are watershed urbanization and exotic species invasion. Research suggests the former is the greater threat in rivers while the latter is the greater threat in lakes. Revising lake level control regulation can help, but the continued development of the watershed will promote flashy hydrodynamics which as significant impact to freshwater mussel populations.

Document Relevance to Reconnaissance Study

This study reports on the decline of mussel populations within the Clinton River Watershed. The report is applicable to the SOW, but will need to be reviewed to extract information relative to the study area. Information presented to this report will be useful for the aquatics, threatened and endangered species, and wildlife sections.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Results	All	All	Presents 2004 inventory of fresh water mussels in the Clinton River Watershed and relates decline in populations to urbanization and changes in river hydrodyamics.

Doc Number	35
Title	Restoring the Flow: Improving Selective Small Dam Removal Understanding and Practice in the Great Lakes States
Author	Small Dam Removal Workshop and Work Meeting
Pub Date	2001

General Summary (document purpose, scope, etc.)

This report addresses general recommendations for facilitating adaptive management, project monitoring, research initiatives, and community outreach for small dam removal initiatives throughout the Great Lakes region.

Document Relevance to Reconnaissance Study

This document is relevant to the reconnaissance study as a general framework for how to approach a dam removal project. It highlights the essential components of a successful community outreach and environmental monitoring project. None of the information provided is specific to the Clinton River AOC or Reconnaissance Study geographic area.

Key Elements for Reconnaissance Study

Element	*Pages*	*Notes*
Project Monitoring Data Collection Recommendations for Facilitating Adaptive Management	12	List of items to be monitored before, during, and after the dam removal project: general monitoring, socioeconomic monitoring, and biophysical monitoring.

Doc Number	36
Title	Conservation Guidelines for Michigan Lakes and Associated Natural Resources
Author	State of Michigan-Department of Natural Resources
Pub Date	March 2006

General Summary (document purpose, scope, etc.)

This document provides guidelines that recommend a watershed approach for protection and management of ecosystem integrity and natural resources of lakes, with development of comprehensive resource assessments and management plans. It identifies general DNR goals and brief description of ecosystem features found in Michigan lakes and riparian areas.

Document Relevance to Reconnaissance Study

This document provides no direct relevance to the recon study.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*

Doc Number	37
Title	Cemetery and Dollar Lake Dam Inspection Report
Author	Oakland County Water Resources Commissioners Office
Pub Date	2007

General Summary (document purpose, scope, etc.)

This document reports the findings of a dam inspection conducted by the Oakland County Water Resource Commissioners Office in 2007. The primary purpose of the inspection is to report the control structure's design specifications, condition, and capacity. It also provides information pertaining to its corresponding lake levels.

Document Relevance to Reconnaissance Study

The information provided in this report provides some useful information pertaining to hydrology and flood control in the corresponding drainage area and would be most applicable to the flood management section. This report does not provide management conclusions. To adequately characterize the flow regime within the area of interest, all of the inspections reports should be obtained and reviewed.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
			Contains measurements and description of structure. May be useful for flood management section.

Doc Number	38
Title	Great Lakes Needs Assessment: Coastal Community Development
Author	Great Lakes Commission NOAA – Coastal Services Center
Pub Date	July 2006

General Summary (document purpose, scope, etc.)

The goal of the needs assessment is to identify and address the needs, barriers, and possible solutions in programs, tools and services to ultimately enable the most efficient development of programs, products and or services to meet those needs within the following three issue areas:

- Coastal Community Development (CCD)
- Data Information Integration and Distribution (DIID)
- Ports and Navigation

This report discusses the methodology, planning, data collection, and analysis for the CCD issue area and is intended to be used by the Center as they plan for a Great Lakes area regional presence and by the GLC as they prepare their upcoming work plan and strategic activities. Secondary beneficiaries are other organizations (state, local, nonprofit, etc.) working on Great Lakes coastal issues who may benefit from the findings of the needs assessment as their organization plans and sets goals with the Great Lakes in mind.

Document Relevance to Reconnaissance Study

As part of this study, several organizations which include state and local governments were surveyed with the intent to identify needs and barriers to develop efficient management strategies. The study covers a large area and primarily focuses on coastal communities. Given this, the study is relevant based on the coastal environments of Anchor Bay and Clinton River East subwatersheds

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
All			

Doc Number	39
Title	Clinton River Sediment Transport Modeling Study-Appendices
Author	U.S. Army Corps of Engineers, Detroit District
Pub Date	2005

General Summary (document purpose, scope, etc.)

To assess potential management problems and to evaluate a wide range of best management practices, a set of computational tools were used to study watershed hydrology, soil erosion, sediment delivery, river channel hydrodynamics and sediment transport. These models provide a general understanding of the hydrologic and geomorphic behavior of the watershed, allowing the prediction of the relative effects of changing land use and the effectiveness of different best management practice (BMP) strategies on subwatershed scale, soil erosion and sediment yield.

Document Relevance to Reconnaissance Study

A wide variety of BMP alternatives were evaluated using the Clinton River Watershed Modeling System. The large-scale effects of changing land use over time on watershed sediment yield and sediment delivery were investigated using the Soil Water Assessment Tool (SWAT) model. The large-scale effects of changing land use over time on watershed sediment yield and sediment delivery were investigated using the SWAT model. Different buffer widths and vegetative types were evaluated for different land use types surrounding the buffer zone using the Gridded Surface-Subsurface Hydrologic Analysis (GSSHA) model. Change in urban density was evaluated by changing lot sizes within the GSSHA hydrologic model.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Watershed Characterization Results	Appendix A		Defines subbasins used in study and gives associated sediment erosion and delivery results
Visualization of GSSHA results	Appendix C		Visualization of GSSHA results using Spatial Data Analyzer (SDA) is provided on an enclosed project CD

Doc Number	40
Title	Fulfilling the Promise for the Great Lakes: Advancing Great Lakes Restoration and Economic Revitalization
Author	Great Lakes Commission
Pub Date	2010

General Summary (document purpose, scope, etc.)

This document is a four page pamphlet containing information regarding the Great Lakes Restoration Initiative and the Great Lakes Commission Federal Priorities for the 2011 fiscal year. The priorities detailed include:

- Maintain or increase funding for the Great Lakes Restoration Initiative
- Protect water quality through the Clean Water and Safe Drinking Water Revolving Funds
- Establish strong protections against aquatic invasive species
- Strengthen regional coordination and federal-state collaboration

Document Relevance to Reconnaissance Study

This document pertains to the entire Great Lakes system. However, the priorities can be applied to the study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Entire document	All	All	Provides priorities of the Great Lake Commission and the Great Lakes Restoration Initiative.

Doc Number	41
Title	Analysis of Altered Hydrologic Regime in the Clinton River
Author	Bruce Halverson, Rob Nairn, Alex Brunton, and James P. Selegean
Pub Date	2006

General Summary (document purpose, scope, etc.)

Alterations of hydrologic processes can increase runoff response have significant effects on erosion and sediment transport. Substantial portions of the Clinton River Watershed have undergone land use changes from primarily agriculture to urban, especially within the last 10 to 15 years. A preliminary assessment was conducted using a flashiness index, to determine if any significant changes in the hydrologic processes of the watershed have occurred over the last 30 to 40 years in response to land use change.

Document Relevance to Reconnaissance Study

The flashiness index was calculated for all stream gages with a minimum of 20 years of record. Results indicate a strong correlation between increasing and decreasing flashiness with changes in watershed land use. The only gage which is located within the area of interest for this reconnaissance study does not show any change in flashiness over time.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Land Use Hydrologic Trend Map		4	Display of all gaging stations used in flashiness study with associated hydrologic trends over their period of record.

Doc Number	42
Title	Clinton River Trail Opportunity Plan
Author	Oakland County Planning and Economic Development Services
Pub Date	

General Summary (document purpose, scope, etc.)

This section of the Clinton River Trail Opportunity Plan begins in Waterford Township along route which passes through the city of Pontiac, Auburn Hills, and Rochester before exiting Oakland County, Michigan

Document Relevance to Reconnaissance Study

None. Document not relevant to project study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*

Doc Number	44
Title	Clinton River Greenways Opportunity Plan
Author	Greenways Collaborative, Inc.
Pub Date	November 2003

General Summary (document purpose, scope, etc.)

The Clinton River Greenways Opportunity Plan provides a multi user trail system that traverses the Clinton River that leads to the western edge of our project area in Bruce Township and planned for a larger regional vision of connecting with the Metro Parkway Trail and Macomb Orchard Trail system located within our study area.

Document Relevance to Reconnaissance Study

Regional planning vision of relationship with unimproved trails in the project study area (Metro Parkway Trail and Macomb Orchard Trail). However no implementation actions are including in the Plan. Most standards and BMPs discussed are dealing with issues involving road crossings, however, AOC related projects could review chapters 5 and 6 for elements found in a typical project for review of standards and BMPs utilized for bridge crossings, overlooks, interpretive signage.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 5	All	5-1-5-7	Bridge crossing and overlooks
Chapter 6	All	6-1- 6-4	Interpretive Signage

Doc Number	45
Title	Lake St. Clair Direct Drainage Subwatershed Management Plan
Author	Macomb County Public Works Office Tetra Tech, Inc. LSC DD Subwatershed Advisory Group
Pub Date	31 October 2006

General Summary (document purpose, scope, etc.)

This watershed management plan was completed to: 1) fulfill the National Pollutant Discharge Elimination System (NPDES) Phase II requirements for non-Phase I governmental units in the urbanized area; and 2) make all of the entities represented in the subwatershed eligible for various grant funding opportunities to implement actions for watershed improvement.

The contents of this plan, including the goals and objectives and the actions to meet them, were developed cooperatively by SWAG members with consideration of the input from community leaders, residents, environmental and citizen groups, local businesses, schools, and universities. The content of this document does include areas within the project scope.

Document Relevance to Reconnaissance Study

The planning area covered in this document is almost entirely out of the planning area for this reconnaissance study. However, small portions of East Point, Centerline, Roseville, and Clinton Charter Township – though not in the Lake St. Clair direct drainage – are included in the plan. The portions of these communities in the Clinton River watershed are part of the reconnaissance study. The plan includes a description of existing conditions in the watershed and actions to improve water quality. Proposed actions are divided into eight categories: watershed planning, public education and participation, ordinances and zoning, pollution prevention, stormwater BMPs (non-construction sediment), stormwater BMPs (other pollutants), natural resource management, recreation enhancement. The actions are general in nature and watershed-wide; therefore they cannot be readily used as a source of potential projects for the reconnaissance study.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Inventory of Subwatershed Features	Ch. 2		Natural, social and hydrologic features of study area, including soils, population, flora and fauna
Subwatershed conditions	Ch. 3		Water quality, biological and other indicators characterizing existing conditions; identified problems with crossings, streambanks, etc.

Doc Number	46
Title	NPDES Phase II Watershed Permit Annual Report for Macomb County and Nested Jurisdictions
Author	Macomb County
Pub Date	1 Nov 2008

General Summary (document purpose, scope, etc.)

This document reports on the actions undertaken between 1 October 2007 and 30 September 2008 by Macomb County and its nested jurisdictions to meet the requirements of the county's NPDES permit. These activities are grouped into six main activities: Illicit Discharge Elimination; Public Education; Public Involvement (including subwatershed advisory committees); Stormwater Pollution Prevention; and Other Activities.

Document Relevance to Reconnaissance Study

This document may generally inform the development of the existing conditions characterization in the 905(b) study. It contains information on outfalls,

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Outfall conditions and complaint log	IDEP	23-51	Includes details on issues with outfalls and drains in Macomb County, including a list of complaints addressed over the course of the year. May inform existing conditions description
SWPPI Actions		146	Potential project – riparian buffer construction at road crossings; planned for 2012

Doc Number	47
Title	Macomb County Trails Master Plan
Author	Macomb County/Wade Trim/MDOT/Greenways Collaborative
Pub Date	November 2004

General Summary (document purpose, scope, etc.)

This Trails Master Plan was developed with community input in identifiying existing trails and potential trails.

This Plan highlights three trails that could provide direct improvements to existing BUIs. The Stony to Metrobeach Trail, Blueway Trails (Red Run Drain and Mt. Clemens), and Clinton River Spillway Trial proposed projects all called for special studies to follow for potential development. Follow up on these projects planned in 2004 should be addressed.

Document Relevance to Reconnaissance Study

Macomb County is the predominant jurisdiction within the project area. The information provided in this plan is immediately relevant to potential developments and other related sections.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Implementation and Strategy	Chap. 5	All	Details on specific projects to embark upon at planning stage

Doc Number	49
Title	Red Run Subwatershed Management Plan
Author	Macomb County Public Works Office Tetra Tech, Inc. R2W Subwatershed Advisory Group
Pub Date	31 October 2006

General Summary (document purpose, scope, etc.)

This watershed management plan was completed to: 1) fulfill the National Pollutant Discharge Elimination System (NPDES) Phase II requirements for non-Phase I governmental units in the urbanized area; and 2) make all of the entities represented in the subwatershed eligible for various grant funding opportunities to implement actions for watershed improvement.

The contents of this plan, including the goals and objectives and the actions to meet them, were developed cooperatively by SWAG members with consideration of the input from community leaders, residents, environmental and citizen groups, local businesses, schools, and universities. The content of this document does include areas within the project scope.

Document Relevance to Reconnaissance Study

The planning area covered in this document is a subwatershed of the Clinton River Watershed and falls within the planning area for this reconnaissance study. The plan includes a description of existing conditions in the watershed and actions to improve water quality. Proposed actions are divided into eight categories: watershed planning, public education and participation, ordinances and zoning, pollution prevention, stormwater BMPs (non-construction sediment), stormwater BMPs (other pollutants), natural resource management, recreation enhancement. The actions are general in nature and watershed-wide; therefore they cannot be readily used as a source of potential projects for the reconnaissance study. The goals and actions in this study are correlated to the Clinton River AOC BUI delisting targets.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Inventory of Subwatershed Features	Ch. 2		Natural, social and hydrologic features of study area, including soils, population, flora and fauna
Subwatershed conditions	Ch. 3		Water quality, biological and other indicators characterizing existing conditions; identified problems with crossings, streambanks, etc.
Relationship of Goals to BUIs	Ch. 6	Table 6-1	Correlates WMP action categories to Clinton River AOC BUIs.

Doc Number	50
Title	St Clair County Rec Master Plan 2007-2011
Author	St Clair County Parks and Rec Master Plan
Pub Date	March 2007

General Summary (document purpose, scope, etc.)

The St Clair Rec Master Plan guides decision makers in St. Clair County on recreational facilities, projects and opportunities that include project study area within Anchor Bay watershed. Specific land acquisition, capital projects, and programs can be identified for potential project partnerships.

Document Relevance to Reconnaissance Study

St Clair County Rec Master Plan includes numerous projects that can be partnered with USACE in achieving goals that work towards AOC delisting.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 1	Physical Characteristics	Page 19-28	Non-point source prime concern and mitigation plans include park purchase of floodplain, wetland areas
Chapter 3	Rec Inventory	0-20	Discuss relevant projects located within project area
Chapter 5	Goals Objectives and Action Plan	1-10	Discuss the heart of the plan with planned projects. Note, action plan not included in report for specific projects/funding items.

Doc Number	51
Title	Clinton River Greenways Opportunity Plan in Rochester and Rochester Hills
Author	Oakland County Planning and Economic Development Services
Pub Date	

General Summary (document purpose, scope, etc.)

This section of the Clinton River Trail Master Plan is within Auburn Hills, Pontiac, Sylvan Lake, Rochester and Rochester Hills, MI.

Document Relevance to Reconnaissance Study

None. Document not relevant to project study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*

Doc Number	54
Title	Richmond Master Plan
Author	MCKA
Pub Date	Nov 2002

General Summary (document purpose, scope, etc.)

This Master Plan was developed with community input identifies the goals and objectives for the planned growth of Richmond.

Document Relevance to Reconnaissance Study

This Master Plan has no direct relevance to the 405B study.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*

Existing Conditions	1	All	Predominant land use of single family residential will continue leading to further sprawl and non-point source pollution.

Doc Number	56
Title	Washington Township Land Use Plan Map
Author	Community Planning and Management, P.C.
Pub Date	2005

General Summary (document purpose, scope, etc.)

This Land Use Plan shows the predominant land use of rural residential and low density residential

Document Relevance to Reconnaissance Study

The Stoney Creek tributary is surrounded by recreational land use which provides public land rather than private land for any identified projects in this vicinity of the study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*

Doc Number	59
Title	Lenox Township Master Plan
Author	Birchler Arroyo Associates
Pub Date	2002

General Summary (document purpose, scope, etc.)

This Master Plan describes the existing conditions of rural residential, farmlands, and extensive natural features within Lenox Township.

Document Relevance to Reconnaissance Study

Goals and Objectives included providing recreational, open space and parklands for residents. Action to meet this G/O would be in purchasing parkland for protection of natural resources. Due to publication of document, check with community on updates.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Implementation Strategy	13	13-5	Need to follow up with community on any proposed projects.

Doc Number	60
Title	St. Clair County's Northeastern Watersheds Watershed Management Plan
Author	St. Clair County's Northeastern Watersheds Watershed Advisory Group (NEW WAG)
Pub Date	November 2006

General Summary (document purpose, scope, etc.)

This Watershed Management Plan (WMP) is for the purpose of providing a comprehensive storm water management plan to improve and protect water quality and fulfill NPDES Phase II storm water requirements for local public entities. The plan is a comprehensive document that describes the status and conditions of the watersheds, sets appropriate goals and objectives, and describes specific actions that will be used to protect, restore, and enhance the resources in the watersheds.

This plan is for the Lake Huron Direct Drainage Watershed, the Lower Black River Watershed, and the St. Clair River Direct Drainage Watershed.

Document Relevance to Reconnaissance Study

The St. Clair River Direct Drainage Watershed and the Lower Black River Watershed are relevant to this study, as they both discharge to the St. Clair River and flow into Lake St. Clair, near Anchor Bay.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Watershed Profile	1	1-1 to 1-68	An outline of the hydrologic boundaries, historical background, soils, topography, and other watershed characteristics as they relate to current water quality conditions in the watersheds of interest.
Status of Water Quality in the Watershed	2	2-1 to 2-77	A description of the current water quality conditions in the Northeastern Watersheds. Identification of the pollutants with the most significant impact on water quality and the sources of these pollutants.
Prioritized Pollutants, Critical Areas, and Priority Areas	3	3-1 to 3-19	An identification of prioritized pollutants, their source, and their impacts to the watersheds. Priority areas to be protected and preserved and critical areas for corrective action are identified as well.
Watershed Goals and Objectives	4	4-1 to 4-5	Describes the goals and objectives for the three watersheds.
Master Plans and Zoning Ordinance Analysis	5	5-1 to 5-29	An analysis of current community Master Plans and Zoning Ordinances and the County's storm water design standards and recommendations.
Best Management Practices	6	6-1 to 6-51	Describes specific tasks or actions that each community can use to address the goals and objectives of the WMP.

Doc Number	65
Title	Clinton River Canoe Map
Author	Huron Clinton Metroparks
Pub Date	Unknown

General Summary (document purpose, scope, etc.)

This trail inventories a canoe and kayak bluewater trail system from Rochester to Lake St Clair on the Clinton River

Document Relevance to Reconnaissance Study

No direct relevance to study at hand.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*

Doc Number	67
Title	City of Sterling Heights Stormwater Management Plan
Author	City of Sterling Heights
Pub Date	March 2007

General Summary (document purpose, scope, etc.)

This (2007) report describes the necessary measures to reduce the discharge of pollutants from the stormwater drainage system, to protect the designated uses of the waters of the State, to protect water quality, and to satisfy the appropriate water quality requirements of the Federal and Michigan Water Pollution Control Acts.

The document consists of seven parts: an introduction, a public education plan, a public involvement and participation plan, an illicit discharge elimination plan, a post-construction stormwater management program, a construction site stormwater runoff control program, and a pollution prevention and good housekeeping plan. Current watershed conditions are identified within these sections.

Document Relevance to Reconnaissance Study

This report consists of a discussion of each of the “six minimum measures” along with an outline of the tasks, best management practices (BMPs), measureable goals and schedules that the City must fulfill for meeting the permit requirements of each measure.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Watershed Background and Scope	1.8	4	A summarized description of the Clinton River East Watershed and the Red Run Watershed.
Public Education Plan	II	5-16	The purpose and objectives of public involvement for the reduction of discharged pollutants in the stormwater.
Illicit Discharge Elimination Plan	IV	21-32	The purpose and objectives for identifying and eliminating illicit discharges into the storm sewer system.
Post-Construction Stormwater Management	V	33-41	Objectives and efforts for a stormwater master plan to address stormwater management issues for new development and redevelopment at various levels.
Construction Site Stormwater Runoff Control Program	VI	42-47	The objectives and efforts to identify, reduce, and eliminate stormwater runoff pollution from construction sites.
Pollution Prevention Plan and Good Housekeeping Plan	VII	48-58	Objectives and efforts to monitor, evaluate, and improve pollution prevention measures at municipal and municipally-owned facilities.

Doc Number	68
Title	Sterling Heights Surface Water Management Plan
Author	City of Sterling Heights
Pub Date	

General Summary (document purpose, scope, etc.)

This report discusses the goals and objectives for surface water management in the City of Sterling Heights. The objectives are identified for the following goals: enhance recreation, protect water bodies from toxic and non-toxic contaminants, and key action points.

Document Relevance to Reconnaissance Study

This report is not directly relevant to the reconnaissance study. The goals and objectives can be incorporated into identified projects within the reconnaissance study area.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	69
Title	Sterling Heights Parks and Recreation Plan 2010 to 2015
Author	City of Sterling Heights, Michigan
Pub Date	March 2010

General Summary (document purpose, scope, etc.)

This (2010) plan discusses the 5-year capital plan for parks and recreation within the City of Sterling Heights. The plan is separated into eight sections and three appendices. The sections include community description, administrative structure, recreation inventory, description of the planning process, description of the public input process, goals and objectives, and action program.

The purpose of this plan is to discuss the overall goals and objectives of the park system in Sterling Heights. From these goals and objectives, a program of action is discussed for implementation of projects that meet the goals and objectives.

Document Relevance to Reconnaissance Study

Section 1 of this report includes a brief description of the existing conditions. This description includes location; social characteristics; land use patterns; topography; water, fish, and wildlife resources; and soils and vegetation.

Section 3 of this report includes an inventory and description of existing recreational and park facilities within the City of Sterling Heights.

Appendix A includes the 5-year capital program for specific projects to be implemented within the parks and recreational facilities. The majority of projects are not relevant to water quality improvements in the Clinton River watershed. A map of the existing park locations and an analysis of existing facilities within the City of Sterling Heights are also included in this appendix.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Community Description	1	1-4	A description of the plan location area; social characteristics; land use patterns; water, fish, and wildlife resources; soils and vegetation; transportation systems; climate; environmental issues; and zoning within the project location.
Recreation Inventory	3	12-20	An inventory of the existing recreation and park sites within the plan study area of Sterling Heights.
Goals and Objectives	7	21-27	The overall goals and objectives that should be addressed with the implementation of each specified project.
Appendix A	A	28-64	A list of projects included in the 5-year capital program for parks and recreational facilities, existing recreational facilities inventory, and existing park location map.

Doc Number	70
Title	Clinton Township Master Plan
Author	
Pub Date	

General Summary (document purpose, scope, etc.)

This document is a one page map of the Clinton Township land use distribution. Identified land use areas include single family residential, multiple family residential, public/quasi-public, office, commercial, industrial, and floodway.

Document Relevance to Reconnaissance Study

This document is not directly relevant to the Reconnaissance study. This document only pertains to the reconnaissance study in that the Clinton River flows through Clinton Township.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	72
Title	City of Mt. Clemens Township Land Use Master Plan draft
Author	City of Mt.Clemens; Hamilton Anderson Assoc.; Carlisle/Wortman Assoc.
Pub Date	July 2009

General Summary (document purpose, scope, etc.)

This document is a comprehensive land use plan for the redevelopment of Mt. Clemens Township. It includes existing conditions associated with land use, trends, problems, and opportunities, and the goals, objectives, and plan for redevelopment.

Document Relevance to Reconnaissance Study

The document contains no projects or existing conditions information directly related to water resources.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	74
Title	Charter Township of Harrison Master Land Use Plan
Author	Charter Township of Harrison Planning Commission
Pub Date	March 2010

General Summary (document purpose, scope, etc.)

This (2010) report describes land use characteristics and the master plan for future land use.

The document consists of thirteen sections: regional analysis, physical features, existing land use, demographic & economic analysis, thoroughfare analysis, visions & strategies, residential areas plan, commercial & office areas plan, sub area plan, environmental & recreation plan, thoroughfare plan, implementation plan, and design guidelines.

Document Relevance to Reconnaissance Study

This report discusses the land characteristics and future land use plan for Harrison Township, which is located within the Clinton River watershed.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Physical Features Analysis	2.0	2-1 to 2-12	A discussion of the inventory of physical features in Harrison Township that have the potential to influence the location and character of development. Topics include geology, topography, soils, water, woodlands, and wetlands.
Existing Land Use Analysis	3.0	3-1 to 3-8	An examination of the Township's land use characteristics on a classification basis. Each of the Township's individual land use categories are discussed, including the amount of land devoted to each category and the distribution of the uses within the community.
Visions and Strategies	6.0	6-1 to 6-16	Identification of various visions of how and when the community should develop to improve the overall physical environment. Each vision is supported by a strategy designed to serve as a guide in development.
Environmental and Recreation Plan	10.0	10-1 to 10-14	A discussion of the protection of environmental features and integration of natural environmental systems into all developments in a harmonious manner when feasible.
Implementation Plan	12.0	12-1 to 12-8	A description of tools and guidelines through which the Township can improve and operate.

Doc Number	75
Title	Clay Township Phragmites Management Program 2010 Year-end Report
Author	Clay Township Phragmites Management Advisory Board
Pub Date	December 2010

General Summary (document purpose, scope, etc.)

This (2010) report describes the problems and hazards caused by phragmites and a program for the management of phragmites. The management plan identifies action items for the control and removal of phragmites to include creating a coordinator and a volunteer organization, surveying the infestations, establishing prioirity treatment areas, communicating with and educating property owners, assisting with permits and treatment, making chemical and equipment easily available, and exploring sources of funding.

Document Relevance to Reconnaissance Study

This report is a presentation of the hazards and management of the invasive species phragmites, which is present in Clay Township.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*

Doc Number	79
Title	City of Fraser Recreation Plan 2006-2012
Author	City of Fraser Parks and Recreation Commission
Pub Date	2006?

General Summary (document purpose, scope, etc.)

This document reports on plans for improvements to Fraser's park facilities.

Document Relevance to Reconnaissance Study

The plan is not relevant to the 905(b) study; it does not call out water resource conditions or projects.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	80
Title	Shelby Township 2009 Master Plan Update
Author	McKenna Associates, Inc.
Pub Date	June 2009

General Summary (document purpose, scope, etc.)

This (2009) plan is based on the idea that quality of place is the most important quality of a community.

The document consists of seven chapters: an introduction, existing conditions, goals and objectives, community character plan, community facilities plan, thoroughfare plan, and implementation.

Document Relevance to Reconnaissance Study

Chapter 2 of this plan discusses the existing physical features (Topography, Soils, Floodplains, Wetlands, and Woodlands) and existing land use characteristics that occur in Shelby Township.

Chapter 3 of this plan discusses goals, objectives, and strategies for future land use decisions in Shelby Township. This section is based on the Existing Conditions Analysis and the community visioning process.

Chapter 4 of this plan is the Community Character Plan and identifies how different parts of Shelby Township should look and function. The Clinton River corridor is identified in the Recreation and Natural Features section of this chapter.

Chapter 5 discusses the plan for parks and recreation facilities. This section identifies the principle goals and recommended improvements to expand the scope of park sites within the township.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Existing Conditions	Chapter 2	5-24	Discusses the regional setting, physical features, existing land use, and population characteristics and trends within Shelby Township.
Goals and Objectives	Chapter 3	25-32	Discusses goals, objectives, and strategies for implementing the townships vision statement to meet its values and desires.
Community Character Plan	Chapter 4	33-74	Identifies all of the component parts that add up to create character within the township.
Community Facilities Plan	Chapter 5	75-78	Discusses how existing public facility plans are aligned with the land use and development policies in this plan. This section also discusses the objectives for enhancing awareness of the relationship between community facilities and the land use needs and requirements.

Doc Number	81
Title	Macomb Township Master Plan 2008
Author	Macomb Township Planning Commission and Community Planning Consultants, Inc.
Pub Date	December 2008 (Amended October 2009)

General Summary (document purpose, scope, etc.)

This plan is for the development of the vacant areas within Macomb Township and to provide for the physical environmental. The plan also addresses promoting the public interest of the residents within the Township. It is a statement of long-range programs to accomplish identified goals and to consider long-range solutions into short-range actions.

The plan identifies existing land development, soils, flood plain, woodlands, wetlands, etc. within the Township.

Document Relevance to Reconnaissance Study

This plan is relevant to this study, as the Clinton River North Branch and Middle Branch flow through the middle of Macomb Township. This plan gives a description of existing conditions within the Clinton River Watershed.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Natural Features of Macomb Township		11 – 17	A brief description, including maps, of the soils, floodplains, water features, woodlands, wetlands, and topography within Macomb Township.
Existing Land Development in Macomb Township		18 – 24	A brief description of existing roads, utilities, and land use within the Township.
Goals for the Development of Macomb Township		65 – 66	An outline of the goals for land use, transportation, natural resources, existing development, community facilities, community appearance, and historical preservation within the Township.

Doc Number	82
Title	Macomb Township Master Plan for Parks and Recreation 2008
Author	The Macomb Township Planning Commission and The Macomb Township Parks and Recreation Department and Community Planning Consultants, Inc.
Pub Date	11 March 2009

General Summary (document purpose, scope, etc.)

The purposes of the Master Plan are to plan for the development of the vacant areas and to provide for the physical environment of the Township. The plan is a statement of long-range programs to accomplish identified goals, and to consider long-range solutions into short-range actions.

This plan includes an inventory of existing recreational facilities, pedestrian and bicycle paths, and golf courses within the Township. The plan provides for the recreation needs of the residents of Macomb Township.

Document Relevance to Reconnaissance Study

This plan contains a majority of the text in the Macomb Township Master Plan 2008. The difference in this plan is that it provides further data for parks and recreation areas within the Township. The goals and objectives for parks and recreation areas are discussed.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Inventory of Existing Recreation Facilities		54 – 71	An inventory of recreational facilities and providers in Macomb Township and the surrounding areas.
Pedestrian and Bicycle Paths		72	A brief description of the goals and objectives for pedestrian and bicycle paths within Macomb Township.
Recreation Goals for Macomb Township		77 – 80	A list and description of recreation goals for Macomb Township. Neighborhood Parks, Community Parks, and Township Parks are identified.
Parks and Recreation Areas		81 – 83	A brief description of the parks and recreation areas within Macomb Township. A map of these areas is included.

Doc Number	83
Title	New Baltimore Downtown Blueprint 2009
Author	Hyett Palma and Michigan Housing Development Authority
Pub Date	1 Dec 2008

General Summary (document purpose, scope, etc.)

This document is a comprehensive plan for redeveloping downtown New Baltimore. It is produced under the auspices of the MSHDA "Blueprints for Michigan's Downtowns" program. It includes survey analysis, market analysis and an action plan for downtown redevelopment.

Document Relevance to Reconnaissance Study

This document is not of relevance to the reconnaissance study. It does not address water resource or recreation issues directly.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Downtown Vision	III	10	"beautiful waterfront" on Lake St. Clair identified as a key asset for New Baltimore

Doc Number	84
Title	City of New Baltimore Recreation Plan 2006
Author	City of New Baltimore Recreation Commission and Community Planning and Management
Pub Date	23 January 2006

General Summary (document purpose, scope, etc.)

This document reports on plans for improvements to New Baltimore's park and recreation facilities.

Document Relevance to Reconnaissance Study

Two parks in New Baltimore are located along the waterfront at Anchor Bay. The plan includes recommendations for these parks that could improve recreation opportunities as well as shoreline stabilization.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Waterfront Park Plan	5	33-34	Includes recommendation to develop boardwalk and undertake marina feasibility study.
Ruedisale Park Plan	5	35	Includes recommendation for shoreline stabilization, noting that the city has lost one-half of the park area to erosion

Doc Number	85
Title	Cottrellville Township Master Plan 2020
Author	Cottrellville Township Planning Commission
Pub Date	June 2002

General Summary (document purpose, scope, etc.)

This document is a comprehensive plan for the growth, development, and redevelopment of Cottrellville Township. It includes existing conditions associated with land use and natural resources within the Township, trends, problems, and opportunities, and the goals, objectives, and plan for growth and development within the Township.

Document Relevance to Reconnaissance Study

The document contains minor relevance to the reconnaissance study. The majority of the Township drains into Lake St. Clair directly, near Anchor Bay, or into the St. Clair River, which discharges to Lake St. Clair, near Anchor Bay.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Natural Features	Chapter 4	4-1 to 4-2	Maps and brief descriptions of the soils, topography, watersheds, floodplains, wetlands, and woodlands within the Township.
Goals and Objectives	Chapter 8	8-3	The goals, objectives, and strategies to protect and enhance the natural features within the Township.
Land Use Plan	Chapter 9	9-5 to 9-6	A brief description of the plan for waterfront parks, the state park, and open space within the Township.

Doc Number	86
Title	Lake St. Clair Monitoring Gap Analysis and Strategic Plan
Author	Great Lakes Commission
Pub Date	October 2003

General Summary (document purpose, scope, etc.)

The plan is an attempt to coordinate and prioritize efforts among monitoring agencies. Partners include USACE, Macomb County, St. Clair County, Macomb County PWC, Office of Oakland County Drain Commissioner, and Southeast Michigan Council of Governments. Results of the monitoring inventory (web based), gap analysis, and monitoring inventory were incorporated into the Lake St. Clair Monitoring Strategic Plan.

Document Relevance to Reconnaissance Study

The strategic plan sets a framework for future environmental monitoring of the lake and surrounding watersheds that should be considered when addressing the AOCs of this project. Many of the monitoring program elements correspond with BUIs of the Clinton River.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Monitoring Inventory		7-11	Description and link to web based monitoring inventory. http://www.glin.net/gis/lkstclair/
Considerations for Coordinating Monitoring		63-65	Examples of other multi stakeholder monitoring programs.

Doc Number	88
Title	Michigan Department of Natural Resources and Environment Lake St. Clair Fish Deaths News Release
Author	Mary Dettloff
Pub Date	March 2011

General Summary (document purpose, scope, etc.)

This news release briefly explains the cause for an increase in dead fish in the Lake St. Clair area during the winter months.

Document Relevance to Reconnaissance Study

This news release is not relevant to the reconnaissance study, as it does not address existing conditions or potential projects to be implemented. Although there has been an increase in fish deaths, this report discusses its relation to the long, cold winter, and not to any water quality concerns in the Lake St. Clair area.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	89
Title	St. Clair River and Lake St. Clair Comprehensive Management Plan
Author	US Army Corps of Engineers
Pub Date	June 2004

General Summary (document purpose, scope, etc.)

This is a coordinated, multi-stakeholder, bi-national management plan to determine sources of pollution in the Lake St. Clair watershed. It includes recommendations for potential restoration measures. It focuses on efforts that may be implemented in the United States portion of the watershed. It includes a vision statement, goals, summary of environmental issues in the watershed, measures for addressing restoration, and an implementation framework. The goals focus on the Lake only (St. Clair River goals are developed in the the RAP).

Document Relevance to Reconnaissance Study

The document characterizes existing conditions in the watershed in a way that may apply to the reconnaissance study. The recommendations for restoration are of a general nature – many are policy recommendations – and are not directly applicable to the 905(b) study. The recommendations do identify responsible parties for implementation, which may be applicable in identifying non-Federal sponsors.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Environmental Health	Ch. 3		Characterizes contributors to water quality problems and other sources of pollution
Habitat	Ch. 4		Characterizes state of habitat and biodiversity, including invasive species
Human Health	Ch. 5		Characterizes impacts on human health of watershed conditions

Doc Number	90
Title	An Ecological Assessment of Great Lakes Tributaries in the Michigan Peninsulas
Author	Riseng, Catherine M.; Wiley, Michael J,; Seelbach, Paul W.; Stevenson, R. Jan
Pub Date	September 2010

General Summary (document purpose, scope, etc.)

The document summarizes a statewide assessment of riverine ecological conditions gathered from multiple sources. Based on a combination of observed and predicted site conditions, 25% of the states, and up to 44% of the St. Clair basin river miles are impaired. The study suggests the importance of assessing the health of tributary watersheds to understand the health of the Great Lakes.

Document Relevance to Reconnaissance Study

Overall, the document is of little relevance to the reconnaissance study as is focuses on a large scale understanding of the condition of all of Michigan's Great Lake Tributaries.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Major Watershed Scores	Table 9	515	The Clinton River Watershed is ranked the 28th most impaired (60.7%) based on a normalized fish and invertebrate score.

Doc Number	91
Title	A Multi-modeling Approach to Evaluating Climate and Land Use Change Impacts in a Great Lakes River Basin
Author	Wiley, M.J., Et. El.
Pub Date	September 2009

General Summary (document purpose, scope, etc.)

Document describes modeling system for ecological forecasting of Muskegon River in lower Michigan using series of linked land cover, climate, hydrologic, hydraulic, thermal loading, and biological response models. The multi-modeling system is based on climate and land use change scenarios and examines how these changes may interact with habitat suitability and biological integrity.

Document Relevance to Reconnaissance Study

Not directly relevant to reconnaissance study or AOC, though approach could be utilized in other watersheds. Also, some data references may be relevant as the Muskegon River is at a similar latitude to the Clinton River.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
MREMS Multi-model structure		247	Overall model structure

Doc Number	92
Title	State-of-the-Art Approaches for Assessment of Great Lakes Nearshore and Large River Fish Habitat-Draft Project Completion Report
Author	Catherine Riseng, Lizhu Wang, Michael Wiley, Edward Rutherford, and Travis O. Brenden
Pub Date	January 11, 2008

General Summary (document purpose, scope, etc.)

The purpose of this project was to identify and assess the effectiveness of existing techniques used in fisheries habitat assessment, classification, rehabilitation, and management in the Great Lakes, and to provide analysis that could be helpful for allocating research and management efforts.

Document Relevance to Reconnaissance Study

This report is not relevant to our reconnaissance study, but does illustrate some up-and-coming technologies that can aid in environmental assessments.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	93
Title	St. Clair County Stormwater Pollution Prevention Initiative Annual Report 2008-2009
Author	St. Clair County
Pub Date	Sep 2009

General Summary (document purpose, scope, etc.)

This document was prepared to comply with requirements under the NPDES general permit. It summarizes specific actions undertaken in St. Clair County between October 2008 and September 2009 to reduce the discharge of pollutants into St. Clair County Watersheds. The SWPPI includes information on total maximum daily loads, public education and involvement, illicit discharge elimination, and efforts to manage construction and post-construction stormwater runoff.

Document Relevance to Reconnaissance Study

The report summarizes actions undertaken to reduce stormwater pollution. The data in the report may be used in summarizing existing conditions and watershed problems.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
TMDL	Table 3		Lists impaired waterways analogous to BUIs

Doc Number	94
Title	Macomb County Stormwater Pollution Prevention Initiative 2010-2013
Author	Macomb County
Pub Date	1 Sep 2010

General Summary (document purpose, scope, etc.)

This document was prepared to comply with requirements under the NPDES general permit. It summarizes specific actions to be undertaken in Macomb County over three years to reduce the discharge of pollutants into Macomb County Watersheds. The SWPPI includes information on total maximum daily loads, public education and involvement, illicit discharge elimination, and efforts to manage construction and post-construction stormwater runoff.

Document Relevance to Reconnaissance Study

The report summarizes actions to be undertaken to reduce stormwater pollution. These actions may be applicable to the Reconnaissance Study's "alternative projects" section. Note that projects are developed only at a very general and cursory level in this document.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
SWPPI Action Table	5.0	PDF 6-14	Tabular summary of projects and actions, classified by responsible party and impact category (illicit discharge reduction, public education, tmdl, etc.)
Structural stormwater controls	App C	PDF 32	List of structural controls operated by Macomb County for existing conditions characterization
Watershed advisory groups	App F	PDF 38	List of participants in subwatershed advisory councils for stakeholder meeting list development

Doc Number	95
Title	Creating a Sustainable Infrastructure System in Southeast Michigan
Author	SEMCOG
Pub Date	July 2010

General Summary (document purpose, scope, etc.)

This report addresses the emerging infrastructure crisis in Southeast Michigan and actions that must be taken in the public and private sector in order to help secure quality of life and economic prosperity in the region. The specific services that are addressed include transportation, water, sewer, and energy. The action steps compiled in this report are designed with regards of creating a quality infrastructure that is fiscally sustainable and supports the region's economy and quality of life.

Major infrastructure services have very high fixed costs. Use of these services has been diminishing so rate increases are required in order to compensate for lost revenue. However, due to pressure to minimize rate increases to customers, maintenance in the short term is often deferred to save money. The improperly maintained infrastructure then deteriorates at a more rapid rate, and the life expectancy of the system is therefore shortened which in turn increases the overall cost because the cost of replacement is much higher than the maintenance cost.

Document Relevance to Reconnaissance Study

This report addresses the actions required to ensure an adequate infrastructure that is fiscally sustainable and supports the region's economy and quality of life. It focuses mainly on policy actions that are needed to ensure proper implementation and does not directly address any specific scientific or engineering actions needed to maintain the infrastructure.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*

Doc Number	96
Title	The St. Clair River Area of Concern Water Use Goals Remedial Measures and Implementation Strategy
Author	Ontario Ministry of the Environment and Energy and Michigan Department of Natural Resources
Pub Date	March 7, 1995

General Summary (document purpose, scope, etc.)

This document, which represents the findings from the Stage 2 RAP, presents the framework for restoring the environmental integrity of the St. Clair River and recommended remedial and preventative actions to reach these goals.

Document Relevance to Reconnaissance Study

Contaminated sediment may have contributed to 5 of 9 BUIs. Parameters of concern in St. Clair River sediment include: total kjeldahl nitrogen, total phosphorus, arsenic, mercury, cadmium, copper, chromium, iron, lead, nickel, zinc, manganese, oil and grease, PCB's, hexachlorobenzene, and total PAH's. The distribution of contaminants in the sediments of the St. Clair River is strongly related to industrial and municipal sources.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Beneficial Use Impairment table		19-20	Summary of Impairments to Great Lakes Water Quality Agreement Beneficial Uses Within the St. Clair River AOC
Contaminants and Sources associated with BUIs		21	Use Impairments and Contaminants Associated with Sources in the St. Clair River Watershed
Sediment Remediation Approaches		68-69	Remediation techniques/options for management of contaminated sediments
Sediment Map		72	Locations of sediment impact zones as defined by the RAP Sediment Task Team

Doc Number	97
Title	The Michigan Department of Environmental Quality Biennial Remedial Action Plan Update for the St. Clair River Area of Concern
Author	Michigan Department of Environmental Quality (MDEQ)
Pub Date	January 2, 2008

General Summary (document purpose, scope, etc.)

The purpose of this St. Clair River biennial RAP update is to track progress on the Michigan portion of the AOC by providing an update on those remedial actions completed in recent years, and BUI assessment results that are based on the readiness of a BUI removal and subsequent technical committee review.

For each of the 10 BUIs in the St. Clair River AOC, this biennial RAP update includes:
- A description of the significance of the BUI based on previous RAP documentation
- A summary of the restoration criteria for the BUI outlined in the *Guidance* document
- A brief summary of relevant remedial actions, if any, completed in recent years
- A brief summary of the technical committee's assessment activities and results, if any, completed in recent years
- A list of annotated references and studies that may be used by a technical committee when the MDEQ AOC coordinator, in consultation with the PAC, determines the BUI is ready for formal review of remedial actions and restoration according to the applicable criteria.

Document Relevance to Reconnaissance Study

The area offshore and immediately downstream of the Sarnia industrial area was found to have severely degraded to impaired benthic communities living in sediments contaminated with a variety of metals and organics. Concentrations of oil and grease, total Kjeldahl nitrogen, arsenic, copper, iron, lead and manganese from Michigan locations. The highest concentrations of chromium and nickel found in sediments along the Michigan shore were classified as moderately polluted. The most heavily polluted sediments were found in the river adjacent or immediately downstream of Port Huron, Marine City and Algonac as well as at the mouths of the Black and Pine Rivers.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Degradation of Benthos		9-10	Benthic communities are impaired in portions of the river due to contaminated sediments
Restrictions on Dredging Activities		10-11	Sediments were found to exceed U.S. EPA concentrations for oil and grease, total Kjeldahl nitrogen, arsenic, copper, iron, lead and manganese.

Doc Number	98
Title	Casco Township Master Plan
Author	Birchler Arroroyo Associates
Pub Date	2005

General Summary (document purpose, scope, etc.)

Master Plan for community describes goals that protect natural features and maintain rural landscapes.

Document Relevance to Reconnaissance Study

No relevant facts for study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element *Section* *Pages* *Notes*

Doc Number	99		
Title	Clay Township Master Plan		
Author	St Clair County		
Pub Date	2002		

General Summary (document purpose, scope, etc.)

Master Plan for Clay Township guides future growth with inventory of existing condition, goals and objectives and future land use plan.

Document Relevance to Reconnaissance Study

Relevant to the study at hand is the fact that nearly 50% of the township is in public domain. Protection efforts involving floodplain and wetland potential projects would have benefit in pursuing projects in Clay Township.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Goals Objectives	7	44	Promote parks and open space
Future Land Use	8	55	Planned Waterfront development

Doc Number	100
Title	Ira Township Master Plan
Author	Community Planning and Management, PC
Pub Date	1998

General Summary (document purpose, scope, etc.)

Master Plan for community

Document Relevance to Reconnaissance Study

No relevant facts for study area other than trails development along water and conceptual waterfront

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Figure 20		116	Trails Map
Figure 21		117	Regional Trails Map
Figure 31		139	Conceptual Waterfront Plan

Doc Number	101
Title	2009-2013 Paint Creek Trail Recreation Master Plan
Author	Paint Creek Trailways Commission
Pub Date	January 20, 2009

General Summary (document purpose, scope, etc.)

Provide framework for direction of the Paint Creek Trailways Commission while guided by providing trail users a natural, scenic, and educational recreation experience while preserving the ecological integrity of the Paint Creek Trail.

Document Relevance to Reconnaissance Study

Generalized community description (Orion Twp and Village of Orion) and future planned project and trail improvements within the recon report study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Community Description	Ch. 3	27-50	Demographics, physical characteristics, and significant projects.
Recreation Inventory	Ch. 4	45	Table 4.7 Orion Township Recreation Inventory Table 4.8. Village of Lake Orion Recreation Inventory.
Recreation Inventory	Ch. 4	79-85	Grant projects, review for within project area.
Accomplishments	Ch. 5	88-94	Table 5.1 Projects accomplished 1992 through 1998, review for within project area.
Goals and Objectives	Ch. 7	133-142	Table 7.1 , pg. 133

Doc Number	102
Title	Clinton River Main Subwatershed Management Plan
Author	Environmental Consulting & Technology, Inc. Carlisle/Wortman and Associates, Inc. Clinton Main Subwatershed Advisory Group
Pub Date	August 2006

General Summary (document purpose, scope, etc.)

The purpose of the Clinton Main Subwatershed Management Plan is to create a vision for long-term protection and restoration of the Clinton Main branch and its associated tributaries. The plan encompasses multiple disciplines, including planning, engineering, ecology, wildlife/habitat, recreation, etc., and outlines the interrelationships of these disciplines within the Clinton Main subwatershed area.

This plan describes the existing conditions and characteristics within the subwatershed which include land use planning, landscape characteristics, river flow characteristics, river water quality, physical characteristics, biological conditions, quality of lakes, state of public opinion and finally a description of prioritized findings within the subwatershed. In addition to a characterization of existing conditions, goals and objectives for the subwatershed are outlined for long-term protection and restoration of the river. The goals and objectives are then accompanied by actions, sometimes referred to as best management practices and management alternatives.

Document Relevance to Reconnaissance Study

Though this is a comprehensive planning document, most of it is irrelevant to the project scope of work. With the exception of a small area within Orion and Oakland Townships, the majority of the subwatershed area is outside the project area. The community profiles for Orion and Oakland Townships may be useful for supplementing information needed in the demographics, water and land use developments, and community and regional growth sections, however, a very small portion of these townships are characterized in this plan.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 3: Existing Conditions	3.1	All	Contains supplementing information needed in the demographics, water and land use developments, and community and regional growth sections

Doc Number	103
Title	Clinton River Watershed/ Area of Concern (AOC) Clinton River Restoration Plan
Author	Tetra Tech, Inc.
Pub Date	2008

General Summary (document purpose, scope, etc.)

The Clinton River Restoration Plan is a comprehensive Remedial Action Plan (RAP) document that updates the actions to address the beneficial use impairments, with the primary purpose being to achieve delisting of the watershed as an AOC through restoration of the eight beneficial uses that have been classified as impaired. One of the most significant findings that came out of the hydrologic modeling results was the cumulative effect of management scenarios in terms of improving water quality. Different BMPs address different issues across the landscape and there is no one management technique that is a cure all.

Document Relevance to Reconnaissance Study

This most recent version document of RAP is relevant to the reconnaissance study by defining a framework in which to understand, assess, and address stressors such as nutrients, pathogens, hydraulics, etc, with respect to the natural environment. The study can be useful in targeting the project study area for the recon report with specific actions.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 4	4.4-4.44	125-172	Stressors that impact the natural environment, point source discharges
Chapter 7	7.39-7.43	273-278	Pollution prevention, water management, CSO and SSO control, groundwater protection
Chapter 7	7.45-7.52	279-286	Soil erosion and sediment control, stormwater best management practices
Flow data	B.1	417-443	Flow data for Clinton River Watershed
Details of Clinton River model	F.3	587-788	Assess existing pollution sources and evaluates the potential benefits of different restoration scenarios

Doc Number	103
Title	Clinton River Watershed/ Area of Concern (AOC) Clinton River Restoration Plan
Author	Tetra Tech, Inc.
Pub Date	2008

General Summary (document purpose, scope, etc.)

The Clinton River Restoration Plan is a comprehensive Remedial Action Plan (RAP) document that updates the actions to address the beneficial use impairments (BUIs), with the primary purpose being to achieve delisting of the watershed as an AOC through restoration of the eight beneficial uses that have been classified as impaired.

Document Relevance to Reconnaissance Study

This most recent version document of RAP is relevant to the reconnaissance study by strategically integrating specific local planning documents (ie. subwatershed plans) with the long term goal of delisting BUIs. The study can be useful in targeting the project study area for the recon report with specific actions.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 2	2-3,2-4	40,41	Jurisdictional and subwatershed listings specific to recon report study area
Chapter 3	3-38 through 3-50	86-101	Subwatershed characteristics for North Branch and Stony/Paint Creek
Ch. 8, Fig. 8-1	8-1	308	Urbanized areas in project area mandated by NPDES permit to implement Phase I/Phase II actions.
Ch. 8, Fig. 8-2	8-2	310	General timeline milestones for comprehensive list of action items
Ch. 8	8-39 through 8-72	345-379	BUIs of medium to high concern for Paint/Stony Creek and North Branch subwatersheds
Ch. 8	8-73 through 8-76	379-382	Prioritization of actions based on achieving 4 or more objectives for a BUI and modeling recommendation/phase II NPDES permit support

Doc Number	104
Title	Economic Impact of Oakland County's Water Resources
Author	Public Sector Consultants Inc.
Pub Date	2009

General Summary (document purpose, scope, etc.)

As Oakland County grows and pursues its economic development objectives, its natural resources are under increasing pressure. To better understand the impact of Oakland's green infrastructure assets on the local economy, the county retained the services of Public Sector Consultants to prepare an analysis of the economic value of Oakland's green infrastructure assets. This study documents, and quantifies where possible, how green infrastructure (water resources in particular) benefit Oakland County's residents and businesses. The study concentrated on:

- **Estimating recreational values to Oakland County residents**—PSC designed and administered a survey of 600 Oakland County households to determine their recreational use of the county's green infrastructure and water resources. Recreational use levels were multiplied by existing estimates of the value of recreational activities to obtain an estimate of the recreational value of Oakland County's water resources to county residents.
- **Reviewing ecosystem service values**—A literature review summarized the ecosystem services associated with Oakland County's water resources and estimates of the economic value of those resources.
- **Estimating tourism activity and values**—The study used secondary data from Michigan State University's Michigan Travel Market Survey to estimate tourism activity from neighboring states and provinces to Oakland County.
- **Assessing the impact of the county's natural environment on business location decisions and employee recruiting and retention**—PSC designed and administered a survey of Oakland County businesses to assess the importance of the county's green infrastructure and water resources in attracting businesses to the county and on the ability of those firms to attract and retain workers.

The research found that Oakland County's green infrastructure and water resources are a substantial source of value to county residents, visitors, and others who live in the five watersheds to which Oakland County's water resources contribute. They also contribute to making Oakland County a desirable place in which to locate a business, play a role in attracting businesses to Oakland County, and make it easier for firms to recruit and retain employees.

Document Relevance to Reconnaissance Study

This document provides the results of how green infrastructure (water resources in particular) benefit Oakland County's residents. Although this document covers all of Oakland County, the results can be assumed to be applicable to the study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Exhibit 2. Oakland County Land Use (2007)	All	All	Provides information regarding Oakland County Land Use.
Key Findings	All	All	Provides key findings of the study.
Household Recreation Survey Conclusions	All	All	Provides conclusions based on the household recreation survey.
Water Based Tourism Conclusions	All	All	Provides conclusions regarding water based tourism.
Ecosystem Services Conclusions	All	All	Provides conclusions regarding ecosystem services.
Business Location and Employee Attraction/ Retention Survey Conclusions	All	All	Provides conclusions based on the business location employee attraction/ retention survey.

Doc Number	105
Title	Effects of Urban Land-Use Change on Streamflow and Water Quality in Oakland County, Michigan, 1970-2003, as Inferred from Urban Gradient and Temporal Analysis
Author	USGS; Stephen S. Aichele
Pub Date	2005

General Summary (document purpose, scope, etc.)

During 1966 - 1970, and again during 2001 - 2003, the USGS collected a series of low-flow water-chemistry samples. This study compares these two water-quality data sets; tests the streamflow data for trends in high flows, low flows, and flashiness; and correlates 2000 land use with water-quality and streamflow data collected during the 2001 - 2003 study. Despite substantial change in land use during 1980 - 2000, little evidence is found in the time-series data of alteration of the daily streamflow characteristics or nutrient enrichment in the study watersheds. Although the absence of these changes may be the result of increased stormwater management requirements and changes in development patterns, it is also possible that the changes are not detectable with the data available.

Document Relevance to Reconnaissance Study

This report serves as a trend analysis document illustrating and analyzing changes in streamflow and water quality data specific to Oakland County. This report also summarizes anticipated changes within the watersheds of Oakland County given these current trends. This document is useful in that it provides data specific to the entire county, which includes the majority of land within the AOC.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Pages*	*Notes*
Changes in Streamflow and Water Quality Through Time	16-20	Five watersheds showed significant trends in low flows, one watershed showed a significant trend in peak flows, and none showed a significant trend in variability over the 33-year period. Relatively little change was observed in water chemistry, although phosphorus and sulfate concentrations were generally lower and chloride concentrations were generally higher in the 2001–2003 sampling compared to the 1966–1970 sampling.

Doc Number	106
Title	Great Lakes Regional Collaboration Strategy
Author	Great Lakes Regional Collaboration Executive Committee
Pub Date	December 2005

General Summary (document purpose, scope, etc.)

The intent of this document is to be used as a guide for decision making and funding sources as an important benchmark in judging funding requests and project proposals by the various Collaboration partners. It does not identify every action or funding avenue that will help achieve the desired end.

This report provides a discussion of the problems that have seriously compromised the environmental health of the Great Lakes. Though several issues and stressors are covered, the main challenges that are identified are as follows:

- Ecological and economic damage caused from the introduction of additional aquatic invasive species.
- Sewer overflows, fro past and ongoing development, which have contaminated water, compromised Great Lakes habitats in coastal areas, and adversely affected Great Lake recreation.
- Non point pollution sources which have continually impaired water quality and related problems.
- Although releases of toxic pollutants have been reduced significantly over the years, there is a legacy of contamination in sediments and fish throughout the system.
- While large amounts of data and information on the Great Lakes have been collected over the years, not enough of that has been transformed into knowledge about the key indicators of the health of the ecosystem.

In conjunction with these stressors, new ones have been identified which has prompted changes to the ecosystem to occur rapidly and unexpectedly. As a result, there is a new sense of urgency for action on the highest priorities for restoring and protecting the Great Lakes.

This document also provides the full range of recommendations, options, and ideas generated by the Collaboration Strategy Teams as well as a rough cost estimate to implement these recommendations over the entire Great Lakes Watershed. These actions highlight the highest priorities recommended by the Teams for early implementation. Additional actions, as well as much more supplemental information, are included in the Appendices to the Strategy.

Document Relevance to Reconnaissance Study

This document focuses on all of the Great Lakes waters and although some relevant issues are addressed, the information provided is broad in nature and not specific to the study area. Information pertaining to fisheries, benthos, and wetlands are discussed in this document, but are characterized from a Great Lakes perspective and does not include specific information about the study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Strategy Team Recommendations		All	Fisheries, benthos, and wetlands are discussed in this document, but are characterized from a Great Lakes perspective
Appendix A		All	Lists all recommendations provided in this report

Doc Number	107
Title	Independence Township Vision 2020 Update Master Plan
Author	Carlisle/Wortman Associates
Pub Date	2006

General Summary (document purpose, scope, etc.)

The purpose of Vision 2020 process has been to identify the goals, policies, programs, and strategies which the Township and its residents wish to pursue. Vision 2020 involved a thorough investigation of past trends, current conditions, and alternative futures for the Township. The overall process has been structured to allow for broad participation, expression of new ideas, and creation of new concepts that will carry Independence Township through the beginning of the 21st century.

The Vision 2020 approach has interrelated all aspects of physical development (i.e. roads, land use, recreation, utilities, etc.) in an attempt to create efficiencies, anticipate unforeseen problems, and search for multi objective opportunities.

The current version of Vision 2020 consists of two documents:

- Background Studies – The Background Studies appendix consists of basic data and information that establish a baseline of conditions in the Township. Background Studies consist of three components: community characteristics and significant trends and identification of community issues.
- Master Plan – The Master Plan represents the long range view of the Township, focusing on more of the traditional elements considered in planning such as future land use, thoroughfares, and community facilities. The Master Plan also takes into consideration the goals and strategies found in the Strategic Plan adopted in 1999. Specific objectives are also identified to address those goals and issues identified through the Master Plan process. As with the Vision 2020 Strategic Plan, adopted in 1999, Target Plans have been developed and updated for various geographic areas of the Township to provide solutions to specific problems and/or issues.

The end result of updates to Vision 2020 is the adoption of plans which will serve as the embodiment of official Township policies regarding the future of the community. The Vision 2020 Update combines the Strategic Plan and Master Plan into one comprehensive document to serve the following functions:

- Provide a general statement of the Township's goals and policies and provide a comprehensive view of the community's desires for the future.
- Define the future character of the community.
- Serve as an aid to both short term and long range decision- making. The goals and policies outlined in the Plans will guide the Planning Commission and Township Board in their deliberations on matters relating to land use and the physical development of the community.
- Assist in establishing priorities for public improvements so that such improvements will provide the greatest benefit to the Township and its residents.
- Serve as an educational tool and provide citizens, property owners, developers, and adjacent communities with a clear indication of the Township's direction for the future.
- Provide direction to private property owners regarding the use of their property.

Document Relevance to Reconnaissance Study

This document provides an overview of background studies utilized for this report as well as narrative that characterizes current and planned land use for Independence Township. Since Independence Township is almost entirely within the area defined by the Scope of Work, this document is relevant.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Background Studies	All	All	Provides an overview of relevant studies
Existing Land Use	All	All	Characterizes existing land use within the Township
Appendix 1	All	All	Provides more detail on the background studies utilized in the plan.

Doc Number	108
Title	Michigan LID Manual
Author	SEMCOG
Pub Date	E

General Summary (document purpose, scope, etc.)

This is a guidance document on low impact development techniques used for storm water management.

Document Relevance to Reconnaissance Study

Not site specific for engineered design utilizing LID concepts, however, provides relevant site data required if LID concepts used in a recommended restoration project for the recon report.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Chapter 3		15-31	Key determinates in using LID concepts in Michigan
Chapter 6		57-121	Non-Structural LID BMPs
Chapter 7		121-334	Structural LID BMPs

Doc Number	109
Title	Oakland Charter Township 2010-2014 Master Plan for Parks, Recreation, Land Preservation and Trails
Author	McKenna Associates
Pub Date	December 8, 2009

General Summary (document purpose, scope, etc.)

This comprehensive plan formulates the road map for the parks, recreation, land preservation and trails for the next five years and projects within Oakland Charter Township.

Document Relevance to Reconnaissance Study

Snap shot of community and action plan items relevant to water projects.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Community Description	Ch. 1	1-9	
Action Plan	Ch. 5	76-91	Review for relevant water quantity/quality projects

Doc Number	110
Title	Oakland County Trails Master Plan
Author	Wade Trim
Pub Date	

General Summary (document purpose, scope, etc.)

Purpose is to document evolution of trail planning and development in Oakland County, easily communicate the coordinated goals and vision for a connected trail system, provide general health and wellness, provide short and long term actions to implement, serve as resource and reference guide for communities, serve as document for future grant opportunities.

Document Relevance to Reconnaissance Study

General community description at county level. Relevant projects in study area derived from Action Plan.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Introduction	Ch. 1	2-21	General county description
Action Plan	Ch. 5	105-116	Review for potential projects in project study area related to watershed improvements

Doc Number	111
Title	Oakland Township Master Plan
Author	Williams and Works Tilton and Associates
Pub Date	January 2005

General Summary (document purpose, scope, etc.)

This Master Plan was developed with community input identifies low impact patterns of development designed to enhance the sustainability of the region as its core principal.

This Plan is designed to serve the Township in the following ways: It provides a comprehensive means of integrating proposals that look years ahead to meet future needs regarding general and major aspects of physical conservation and development throughout the Township. The Plan serves as the official, advisory policy statement for encouraging orderly and efficient use of the land for residences, parklands, services, and infrastructure, and for coordinating these uses of land with each other, with streets, and with other necessary public facilities and services. It creates a logical basis for zoning, subdivision design, public improvement plans, and for facilitating and guiding the work of the Township Planning Commission and the Township Board as well as other public and private endeavors dealing with the physical conservation and development of the Township. It provides a means for private organizations and individuals to determine how they may relate their building and development projects and policies to official township planning policies. It offers a means of relating the plans of Oakland Township to the plans of Southeast Michigan and the Detroit metropolitan area.

Document Relevance to Reconnaissance Study

Oakland Township is entirely located within the project area. The information provided in this plan is immediately relevant to the demographics, water and land use developments, and other related sections.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Natural Features	Chap. 1	All	Provides summary of all natural features within the Township
Population	Chap. 2	All	Discussion trends and projections
Economic Development	Chap. 3	All	
Land Use	Chap. 5	All	Discussion of land use and land cover
Historic and Cultural Resources	Chap. 8	All	

Doc Number	112
Title	Oxford Township Master Plan
Author	Carlisle/Wortman Associates
Pub Date	July 2005

General Summary (document purpose, scope, etc.)

The Charter Township of Oxford Master Plan is an officially-adopted document that sets forth an agenda for the achievement of goals and policies related to land use. It is a long-range statement of general goals and policies aimed at the unified and coordinated development of the Township. It promotes balanced, orderly change in a deliberate and controlled manner that permits planned growth and redevelopment. It also provides the basis upon which zoning and land use decisions are made.

The Master Plan is a policy manual which provides the framework for the Charter Township of Oxford Zoning Ordinance and map. Among the most valuable tools in implementing the plan are the Zoning Ordinance and Subdivision Regulations. Additionally, the Plan considers the goals of the community and provides objectives to achieve these goals.

Document Relevance to Reconnaissance Study

Oxford Township is partially located within the project area. Information used in this report will need to be reviewed for relevance to the project area. The information provided in this plan is immediately relevant to the demographics, water and land use developments, and other related sections.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Background Studies	2	All	Provides an overview of several outside studies that contributed to the plan
Land Use	4	All	Provides narrative of the Township's Land Use Plan

Doc Number	113
Title	St. Clair River and Lake St. Clair Comprehensive Management Plan
Author	U.S. Army Corp of Engineers Great Lakes Commission
Pub Date	June 2004

General Summary (document purpose, scope, etc.)

Section 426 of the Water Resources Development Act (WRDA) of 1999 authorized the U.S. Army Corps of Engineers (USACE) to develop a comprehensive management plan for the St. Clair River and Lake St. Clair. The legislation directed the USACE to coordinate efforts with federal, state and local governments and Canadian federal and provincial authorities and to develop a plan that:

- Identifies the causes and sources of environmental degradation to Lake St. Clair and the St. Clair River;
- Addresses continuous monitoring of organic, biological, metallic and chemical contamination levels;
- Provides for the timely dissemination of information of contamination levels public authorities, other interested parties and the public; and
- Include recommendations for potential restoration measures.

The narrative of this management plant is broken up into nine chapters which highlight the array of programs, policies and initiatives that are in place to build upon in implementing the management plan recommendations. The following is a list of the subject matter by chapter:

- Chapter 1: Introduction to Lake St. Clair and the St. Clair River
- Chapter 2: A Vision for Lake St. Clair and the St. Clair River
- Chapter 3: Environmental Health of the Watershed
- Chapter 4: Habitat and Biodiversity
- Chapter 5: Human Health
- Chapter 6: Land Use
- Chapter 7: Fisheries, Recreational Boating and Commercial Navigation
- Chapter 8: Monitoring
- Chapter 9: Achieving Our Vision

Document Relevance to Reconnaissance Study

This document is a comprehensive management plan that focuses on the entire Lake St. Clair Watershed of which the Clinton River Watershed is apart. Due to the extensive scope of this document, the information can be used to supplement nearly all of the topics listed in the scope of work. Given that the information provided in this document is a characterization of the entire St. Clair Watershed and should be screened for relevance to the study area.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Introduction	Chap. 1	All	Relevant topics include watershed resources, uses, impacts and resource management
Environmental Health	Chap. 3	All	Includes a discussion on point and non point source discharges
Habitat and Biodiversity	Chap. 4	All	Topics include habitat loss, invasive species, and lake levels
Land Use	Chap. 6	All	Includes land use planning, non point source pollution and stormwater runoff
Fisheries	Chap. 7		Topics include fisheries management, lake levels, and contaminated sediments
Monitoring	Chap.8		Some information is included about existing monitoring programs

Doc Number	114
Title	Feasibility for Siting a Septage Disposal Facility for Macomb and St. Clair County
Author	CDM- Macomb/St. Clair Inter-county Watershed Management Advisory Group
Pub Date	October 12, 2004

General Summary (document purpose, scope, etc.)

Macomb and St. Clair counties have approximately 50,000 on-site wastewater treatment systems that were installed prior to adopted county on-site treatment regulations, many of which are now failing due to improper siting and/or maintenance or are beyond their useful life. Proper disposal of septage is essential in order to protect surrounding waters from degradation.

Document Relevance to Reconnaissance Study

As up to half of the flow of the Clinton River is treated waste water, it is essential that adequate treatment is provided. Failing septic systems and improper disposal of septage are listed as sources of impairment to Lake St. Clair by SEMCOG. Location of the septage disposal facility may influence water and sediment quality as septage quantities are expected to increase to 14 million gallons per year by 2030.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*
Advantages and Disadvantages of Septage Treatment Options and Potential Sites	3.3	3-11 to 3-20	Discussion of criteria for developing septage facility and possible locations.
Potential Sites	5	5-1 to 5-13	Discussion of several possible sites in Macomb and St. Clair Counties.
Septage Treatment Facility Design	Appendix F	F-1 to F-4	Conceptual costs and volumes anticipated for septage facilities.

Doc Number	115
Title	Preliminary Analysis of Ecosystem Restoration for the Clinton River Watershed Northern Oakland County and Lapeer County 95% Draft
Author	URS/BAIRD/ECT
Pub Date	March 17, 2011 (Draft)

General Summary (document purpose, scope, etc.)

Prepared a reconnaissance level study (905(b)) analysis and a reconnaissance level report of a geographically limited watershed approach. Investigation may recommend proceeding to the development of a Watershed Management Plan. The Management Plan would (1) integrate existing projects/plans/studies; (2) assess program progress; and (3) plan future river and watershed restoration programs and projects from various Federal, state, local and non-governmental organizations into a comprehensive Clinton River Watershed Management Plan. The Plan will be used as a tool for local stakeholders and watershed groups to move toward the restoration of the Clinton River Watershed. The Plan may identify further studies and/or additional projects that could be individually implemented.
As this Reconnaissance Study proceeded, it became apparent that several in-depth studies and investigations of the problems, impairments and degradations to the Clinton River Watershed had been completed by others, and that potential improvements had already been identified at various locations throughout the watershed. The locations, costs and basic scope of ten of these improvements are identified in this Reconnaissance Study. As such, the Reconnaissance Study team will collaborate with the stakeholders as to the progression of future work between proceeding with a Clinton River Watershed Management Plan.

Document Relevance to Reconnaissance Study

The document provides relevant studies for cross referencing in our project study area that overlap both projects. Existing conditions are relevant for those areas that were cross referenced to be inclusive in both study areas. Relevance to problems and opportunities for both study areas that are associated with both projects.

Key Elements for Reconnaissance Study (per Table of Contents)

Element	*Section*	*Pages*	*Notes*
Table of Contents	All	All	Although none of the ten projects are relevant to our study area, the table of contents and structure of report can be utilized for our study.

Doc Number	116
Title	Fish Survey Data Reports for Various Waterways
Author	Michigan Department of Natural Resources (Jim Francis)
Pub Date	05 April 2006 – 31 March 2011

General Summary (document purpose, scope, etc.)

The fish survey reports written by Jim Francis of the Michigan Department of Natural Resources were conducted on Crapaud Creek, Auvase Creek, Marsac Creek, and Meldrum Drain between April 5, 2006 and March 31, 2011. The reports describe the location, length, and current condition of the waterways.

A summary of the analysis procedures, results, and conclusions are included in each report. Aerial view satellite maps are included to identify the specific locations of the study areas. General recommendations were included in two fish survey reports to enhance fish habitats within the waterway.

Document Relevance to Reconnaissance Study

Two fish survey reports (Meldrum Drain and Auvase Creek, 31 March 2011) included recommendations to enhance fish habitats within the waterway. Recommendations were general and specific projects are not well developed. Therefore, these reports do not have significant relevance to the reconnaissance study.

Key Elements for Reconnaissance Study

Element	*Section*	*Pages*	*Notes*